https://doi.org/10.5194/egusphere-egu2020-11421

Perspective of the rehabilitation of marginal areas: the case of *Lablab purpureus* (L.) Sweet

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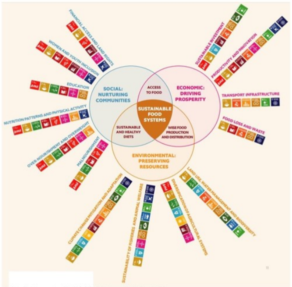
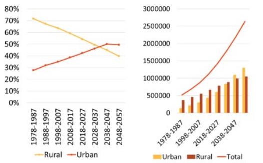
Unsuitable agriculture practices
Improper solid waste management
Unsafe storage of hazardous chemical and nuclear waste
Leachates from mismanagement landfills
Uncontrolled dumping of waste from households, industrial plants and mining
POTENTIALLY HAZARDOUS ELEMENTS (PHE)
SOIL AND WATER CONTAMINATION
SUSTAINABLE DEVELOPMENT GOALS

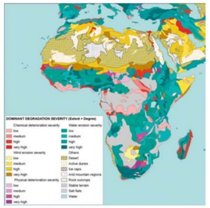
1 **It is estimated that the world population reach 9.1 billion in 2050 resulting in increasing food demand and consumption, but also waste production. Moreover, to help achieve the goals set by the 2030 Agenda for Sustainable Development, it is imperative to develop sustainable strategies for the recovery marginal lands (e.g. landfills or abandoned mining areas) and create conditions for agriculture activities. Thus, there is a need to increase agricultural production and to create sustainable waste management approaches. Several landfills pose health and environmental concerns associated to non-selective deposition of wastes, which present potentially hazardous elements (PHE), and inexistence of environmental management systems. Therefore, leachates rich-in PHE can spread to adjacent areas leading to soil and water contamination.**



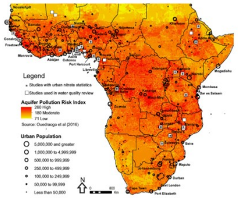
2 **Landfills, poses environmental and health concerns due to the presence of potentially hazardous elements (PHE) and this is particularly concerning considering the growing rate of Sub-Saharan African (SSA) population that will be living in urban or peri-urban areas, and practice subsistence farming in those areas. For SSA it is estimated that by 2050 about 50% of the population will be living in towns and cities.**



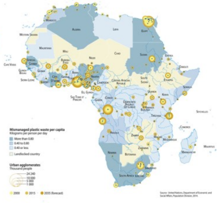
Annual growth of population in rural and urban regions in sub-Saharan Africa within the period of 1950s and to future projections until the 2050s [1]



Soil degradation severity, by type extent, and degree [2]



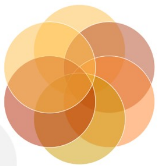
Relationship between urban centres in SSA and estimated aquifer pollution risk. [3]



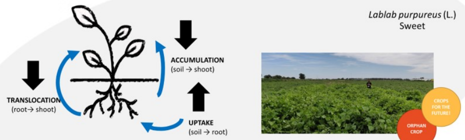
Waste generation rates and urban population centers in Africa [4]

3 **In SSA, urban and peri-urban agriculture, is essentially, a "local food" system that provides urban populations with a wide range of fruit and vegetables, but also herbs, roots, tubers and ornamental plants that are grown within the city or in its surrounding areas. Where irrigation is fully available – the case in most African cities – urban and peri-urban farmers establish plots along permanent water courses, including rivers, streams, drains and sewage canals, or in marshy areas where they dig wells to reach groundwater. However, rudimentary sanitation and cities with poor domestic and industrial waste management result in severely polluted water from streams, urban drains, and even groundwater, threatening food safety**

4 **The recovery of landfills, in addition to other environmental management measures, can involve the development of a secure plant cover that creates conditions for agriculture activities, while protecting the food-chain, but also improve environmental and landscape impacts. Plant species selected for green cover should have the ability to decrease the mobility or immobilize PHE in the rhizosphere. Furthermore, these plant species should also have low PHE translocation factors from the soil/roots to the shoots. Plants with these characteristics are not common, and it is necessary to increase our efforts to identify them. Moreover, in the scope of SSA it is important that these species should be native and known by the population. One of such plants is *Lablab purpureus* (L.) Sweet, commonly known as Lablab.**



5 **Lablab is a legume from East Africa, better adapted to long periods of drought than common bean or cowpea, both of which have been preferred in African agricultural production systems. Nevertheless, Lablab is still produced locally for household consumption and for the sustainability of the African smallholder multifarming system [1]. Lablab multifunctionality (food, feed, green manure) and drought resistance make this crop a potential candidate for the rehabilitation of contaminated areas.**



Lablab has high PHE (Cu, Zn, As, Hg, Pb) uptake, but low translocation that was translated to a low accumulation if the shoots. This low accumulation allowed that PHE concentration in the shoots to be tolerable to domestic animals for plants [5].

6 **It is important to point that the characteristics of each landfill are different as well as climatic conditions where is located the landfill, thus the initial and multidisciplinary characterization of the study area is crucial.**
Moreover, the ecophysiological plant behaviours, namely PHE accumulation in the edible part, depends on plant species and edafoclimatic conditions, so more studies should be done in order to assess the impact in the food-chain.

REFERENCES
[1] Vidigal, P., Manuel Romeiras, M. & Monteiro, F. Crops Diversification and the Role of Orphan Legumes to Improve the Sub-Saharan Africa Farming Systems. in Crop Production [Working Title] (IntechOpen, 2019). doi:10.5772/intechopen.88076; [2] ELD Initiative & UNEP (2015). The Economics of Land Degradation in Africa: Benefits of Action Outweigh the Costs. Available from www.eld-initiative.org; [3] Lapworth, D. J. et al. Urban groundwater quality in sub-Saharan Africa: current status and implications for water security and public health. Hydrogeol. J. 25, 1093–1116 (2017).; [4] Jambeck, J. et al. Challenges and emerging solutions to the land-based plastic waste issue in Africa. Mar. Policy 96, 256–263 (2018).; [5] Abreu, M. M., Monteiro, F. & Vidigal, P. A green solution for the rehabilitation marginal lands: the case of Lablab purpureus (L.) Sweet. in EGU General Assembly 2020 5637 (2020). doi:10.5194/egusphere-egu2020-5637.

Funded by: STEnCIL | PDR 2020 Programa de Desenvolvimento Rural 2014-2020 | Portugal 2020 | The European Agricultural Fund for Rural Development Europe investing in rural areas | LEAF Linking Landscape, Environment, Agriculture and Food | CENTROP | cef | Instituto Superior de Agronomia | Universidade de Lisboa

https://doi.org/10.5194/egusphere-egu2020-5637

A green solution for the rehabilitation marginal lands: the case of *Lablab purpureus* (L.) Sweet

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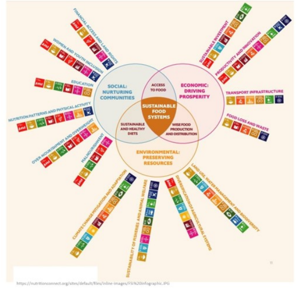
Poor agriculture practices
Intensive extractive activities
Mine wastes and leachates
Generation and circulation of acid mine drainage, rich-in
POTENTIALLY HAZARDOUS ELEMENTS (PHE)
SUSTAINABLE DEVELOPMENT GOALS
SOIL DEGRADATION
WE NEED TO INNOVATE IN HOW WE EAT AND FARM

1 **With the increasing population growth rate, and in order to attain the goals set by the 2030 Agenda for Sustainable Development, it is necessary to find solutions that can ensure food security and food safety. Population growth implies not only increasing food demand, but also land use for housing, which ultimately will result in the need to claim more land. With only 30% land available in the world, it is crucial to find strategies to answer the demands for the near future.**



New approaches to **managing waste**, water and energy in food supply chain

Government and private investment in the **production of alternative crops, new production systems**

Restoring/Rehabilitate degraded farmlands, wetlands, forests and **marginal lands**

2 **A potential strategy could be the reclaiming/recovery of marginal lands, such as salt and drought prone lands, or even abandoned mining areas, that are not suitable for farming. The latter is still a controversial approach, because of the knowledge void, as to determining pollution level, environmental and health risk assessment protocols, contaminated sites identification, all factors that can diminish the success of sustainably recover abandoned mining areas. Mining activities result in soil degradation, environmental contamination and thus ecosystem disruption [1].**

Contaminated areas

IBERIAN PYRITE BELT

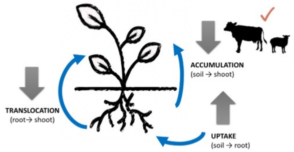
Mine wastes = High total concentrations of PHE + low pH, organic C and nutrients + Poor structure + Low water holding capacity

3 **Soils from mining areas are rich in potentially hazardous elements (PHE) that cannot be degraded, thus there has been recent efforts to create sustainable ecotechnologies that could rehabilitate these areas, creating conditions for agriculture activities while assuring food safety. Germination and development of the vegetation directly on tailings and contaminated soils can be very difficult, especially in areas with Mediterranean climate. The slow plant growth can limit the environmental rehabilitation success. Phytostabilisation is a prospective rehabilitation strategy that uses plants with immobilization PHE capacities and most especially with low translocation factors of PHE from the soil/roots to the shoots. The discovery or development of crops that can maintain high yields under extreme climatic and contaminated soil conditions can be key for phytostabilisation success.**

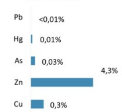
A mix of wastes from the contaminated site (e.g. *gossan*) with other organic wastes (e.g. livestock manure, plant residues, compost) and inorganic wastes (e.g. liming materials, hydrophilic polymers, biochar). This ecotechnology, promotes: (i) different biogeochemical and edaphic processes; (ii) decreases the PHE bioavailability; (iii) improves physicochemical characteristics of the substrata for the growth of plants and soil microbiota; (iv) circular economy

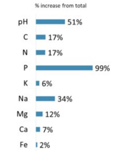
Lablab purpureus

Technosols



PHYTOSTABILISATION





4 **Major crops such as maize, rice and wheat are the sustenance of a big part of the world food supply needs, but unlike undervalued crops, often called orphan crops, are not easily adaptable or have the genetic diversity that allows them to yield under harsh growing conditions. Orphan crops are thus designated, crops that have been neglected for commercial production purposes due to the lack of interest and investment from policymakers, researchers and farmers in detriment of more profitable crops. Yet, the high potential that these crops hold as food, nutritional source, multifunctionality and environmental elasticity are unquestionable, and thus often are referred as crops of the future. One of those crops is the multifunctional (food, feed and green manure) *Lablab purpureus* (L.) Sweet, common name Lablab bean [2]. Lablab bean growing in Technosols showed no symptoms of toxicity, with high PHE uptake, low translocation that was translated to a low accumulation if the shoots in concentrations tolerable to domestic animals. The results showed that phytostabilisation with Lablab is a potential strategy for rehabilitation of mining areas.**

References:
[1] Abreu MM, Magalhães MCF. Phytostabilization of soils in mining areas. Case studies from Portugal. In: Aachen L, Eichman P, editors. Soil Remediation. New York, NY: Nova Science Publishers Inc.; 2009. pp. 297–344.
[2] Vidigal P, Manuel Romeiras M, Monteiro F. Crops Diversification and the Role of Orphan Legumes to Improve the Sub-Saharan Africa Farming Systems. Crop Production [Working Title]. IntechOpen; 2019. doi:10.5772/intechopen.88076

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