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AGROECOLOGY METHODS FOR OLIVE OIL PRODUCTION ATSAS CASE STUDY

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ESTABLISHMENT OF TREES

SITE ANALYSIS

Atsas farm overlooks the Turkish occupied village of Petra. The 38-hectar land is located in one of Cyprus' driest areas, receiving an average precipitation of 250 mm per year – one of Cyprus' lowest rainfall levels. The site is located next to the sea with temperatures during the summers often rising above 40 degrees celsius. Though terrain is similar to the worldwide unique geology of Troodos' mountains, resources on site are almost non-existent: pretty much no top soil available and with limited water resources.

The vision of the plot's owner was to invigorate the land and turn this arid rocky landscape into a productive agro ecosystem. First step to establish the desired olive grove was to survey the land and record all existing elements.

A first survey recorded all growing native plants. Life was very scarce at the beginning in this arid piece of land, apart from a few dryland pioneer plants.Six plants of crataegus azarolus were recorded, a species of hawthorn, as well as twenty ziziphus lotus and twenty capparis spinosa. A first goal was to help establish more life-attracting features and create wildlife corridors throughout the site. These features help invite in wildlife by offering food and shelter to a plethora of species necessary for the pollination, natural pest management and fertilization of the land.

Designing more integrated pest management features within the system is always desired. Hawthorn for example, becomes a shelter for wild birds. Birds feed on insects and pests that can affect crop and eventually help keep their population under control. Ziziphus lotus on the other hand is well known for its hydraulic redistribution function: its roots can go down to hundred and fifty meters deep, tap into to water and pump it right up where its needed. More plants can grow in these humid oases, which then become hosts for more wildlife like wild rabbits and birds. Birds bring in seeds of more plants, like wild asparagus, which they spread around through their droppings and eventually create an even denser and more diverse ecosystem. According to

agro-ecological principles, diversity brings stability and by designing variety we help create more resilient systems.

A second survey took a look on the morphology of the land. Erosion galleys featured on the entire site, reflect rain patterns and the flow of water moving across the bare land in every rainfall. To address erosion, rock check dams were created: piles of rocks were placed across the erosion galleys. Every time rain pours down, water is slowed down as soon as it reaches the rocky walls, allowing water to infiltrate within the soil and more top soil to accumulate there. These rock formations are also a pole of attraction to birds, and eventually bring more plant life in: wild asparagus, juniper, even reeds are found growing on our constructed check dams addressing even further erosion control.

In one large erosion galley, a 17k cubic meter dam was created. To calculate this water harvesting feature's size, irrigation needs were estimated according to the needs of a fully planted orchard at a mature size. The dam was chosen to be placed high up on the land, just below built structures. Catchment area for the dam includes the rocky hill on top, the neighbor's bare piece of inclined land, access roads as well as all the buildings' roofs. A silt pond was also created diverting all collected water to first pool in there, allowing first silt to settle and then overflow towards the dam. This deposited fertile soil is collected once a year and used as a potting mix, and in aromatics and flower planting. By having this harvested water on site, one year's irrigation needs are assured. In the possibility of consecutive years of drought, as a backup, the system is connected to the overflow of the 4500k-ton capacity Solea dam.

Soil, erosion and wildlife vegetation actions prepare the ground for the next step: the planting of the trees. The chosen trees are always grafted olive seedlings. This method is preferred rather than rooting cuttings, as plants grafted on wild olives' rootstock tend to be much hardier than cuttings. For planting, forty-centimeter diameter holes are drilled, and trees are placed inside.

Trees are instantly pegged to keep them stabilized from prevailing winds. Pegs are always adjusted to the tree's trunk with biodegradable threads avoiding any damage. The pegs are not removed until two years at least have passed. Each hole is then backfilled with the excavated soil and without adding any extra amendments. When compost, manure and fertilizers are mixed in the hole potting effect occurs: the roots of the young tree tangle around a very narrow area instead of spreading out in search for water and nutrients.

FERTILIZATION

After the hole has been filled, an organic fertilizer containing 12% nitrogen, is added on the top, in a distance from the tree's trunk. Care needs to be taken as to means of fertilization chosen. When compost is added, great care should be taken as the release of nitrogen is accumulative throughout the years and could result to leaf overgrowth and lower production of fruit. If manure is added instead, trees could stress over the high salt content. Beyond the first installment, fertilizer and compost are added to the trees every year during the winter.

After trees are planted, they are inoculated with Arbuscula Mycorrhiza, a type of fungi that stimulates plant growth by establishing a symbiotic association with the plant. The fungal mycelium acts as an extension of the plant's root system optimizing the use of soil, water and nutrients. Care must be taken to maintain the fungi alive by avoiding tilling the soil, using any synthetic fertilizers or adding copper to the soil.

IRRIGATION

To establish irrigation, trees are organized in sections of hundreds. Main irrigation pipes are buried under the soil to keep them off sun's damaging rays. Self-regulated drippers are then connected to the main line and placed under each tree. The drippers are always placed on each tree's drip line to help extend the system's roots. As the tree grows, these need to be adjusted to correspond to the expanding tree canopy. Irrigation is done in such way to train trees to tolerate lack of water. Trees are left without irrigation until their leaves are seen turning away from the sun. This is an indication that they are water stressing and that they should be promptly irrigated. The most crucial period to irrigate olive trees is during the winter, especially if we don't receive enough rainfall. When trees get sufficient water during the winter months, a more intense flowering is observed during spring. Trees are mostly irrigated during flowering and not so much when olives have been formed. Our overall irrigation goal is to train our olive trees to need less and less water, eventually reaching to the level of no supplemental irrigation after ten to fifteen years. A mission as optimistic as this can be achieved through a patient soil rejuvenation by employing many different techniques including holistic grazing, which we mention further on.

GROUND COVER

Different varieties of local grass are sown on site and used as a groundcover. This is achieved either by creating and spreading custom-made seed balls or by seeds brought in by passing wildlife. The site happens to be located in an important bird area (IBA) and so we welcome biodiversity in by creating attracting features for birds to enter our land while their passing from the area. Several varieties of the local nitrogen fixer medicago, such as medicago scutellata, are sawn in early autumn and then left to grow. We strongly embrace the notion that a living soil is a covered soil and so ground cover is left to grow throughout the year. No tilling of the land is done whatsoever on site and grass is cut only when there is a very high chance of fire. Even then though, strips of grass are left standing across the land. Along with the shelter provided by our productive trees and wild bushes growing, these wildlife corridors attract in auxiliary insects. In an agroecology field one depends greatly on the activity of auxiliary insects and so we do as much possible to create the ideal circumstances to host them on site.

PEST MANAGEMENT

Inula viscosa, one of the types of plants found growing wild in the area, apparently holds one of the greatest roles in the site's integrated pest management. The yellow flowering plant with the distinctive smell, hosts eupelmus urozonus, a parasitic wasp and the main predator of olive fly – the biggest pest thread for an olive grove. Inula viscosa also hosts a range of auxiliary birds. To monitor the appearance and progression of olive fly, yellow sticky traps infused are placed in strategic places all across the orchard. When weather conditions are beneficial for the reproduction of the fly these are monitored every single day. If several olive flies are seen, traps are installed. In an empty plastic bottle a mixture of ammonia and pheromone is poured and then hanged on the trees to allow the reduction and control of olive fly's population in a selective way.

Olive psyllid (euphyllura olivine) another pest affecting olive trees, is controlled by spraying trees with oil before spring comes. By boosting the field's biodiversity, olive psyllid's predator is also welcomed in: a parasitic wasp that feeds on this scale family pest and keeps its population under control.

A third olive tree pest, the scale, is known to have a symbiotic relationship with ants. Instead of finding a way to fight with the pest itself effort is done to deter ants from approaching olive trees from the start by attaching strips of glue on their trunks.

TREE PRUNING

Pruning does not begin until four years from the planting of the tree. Suckers though and any wild branches growing on the trunk, are cleaned out right from the beginning. In year four, pruning is done to suit our chosen harvesting method: all olives are harvested by hand very gently to avoid any unwanted bruising that might lead to oxidation and result to high acidity on the extracted oil. The form of an open weeping vase is chosen and trees are kept short to make collection easy. This formation offers good aeration to the tree and a good repartition of the sun. Pruning is done during the period of descending moon and when it's still cold in winter.Right after, follows the spraying of the trees with copper, acting as an anti-fungi on any open wounds on the tree.

INCREASING PHENOLIC CONTENT

Our research and experiments show a higher phenolic content in olive trees teamed up with mycorhiza fungi. This beneficial fungi living in synergy with plants, is bringing up micronutrients from the soil and making them available for the plants to assimilate.

One of our priorities is to continuously work on improving our soil's biology. Every plant undergoes the essential process of photosynthesis, the majority of it being utilized to feed the millions of microorganisms in the soil. Processes such as carbon sequestration from the atmosphere, or nutrients released every time an organism dies, all eventually end up enriching the soil and boosting the present microorganisms with available nutrients. The greatest the variety of life that thrives in our soil, the more efficiently these nutrient cycles act.

To speed up the process of regeneration of our soil biology, holistic grazing will be implemented in the near future. One of the most efficient livestock to serve this purpose for our case, are minicows – an indigenous species of India. These minicows, a mini version of their voluminous well-known relatives, are extremely resistant to heat – a necessary characteristic to be able to cope with the extremes of temperatures featured on site. These cows are also very hearty and resistant to diseases and as a bonus, they produce rich fatty milk. Holistic grazing is designed to start four years after trees have been planted and the amount of cows implemented will depend on the addressed stretch of land.

The cows' primary feeding source during the winter and early spring, will be the nitrogen fixing plants growing all across the land, while hay put aside in the winter, will be used as food for the driest months of the year: summer and early autumn. While the livestock feeds on the ground cover, nitrogen is released back in the soil through the plants's nitrogen nodules. Fertility will be further on boosted through the livestock's manure spread all across the land. Soil biology will

slowly start to build up and this cycling of nutrients will eventually eliminate the need for fertilization.

In all aspects, a system is designed that will eventually be able to work on its own. Wildlife is invited in to help with pest management and enhance fertilization. Groundcover will keep soil covered at all times and will feed and be fed by the holistic grazing system ending up to all life forms collaborating in keeping the system in balance and maintaining the input of human labor to the minimum.

Bibliography