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Creating the Forest Garden

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After observing the diversity of tropical systems in Nepal and Nicaragua and in particular their rapid establishment, Jerome Osentowski, inspired by Bill Mollison's elaboration of the succession of sub-tropical systems, (*Permaculture International Journal* 40:24) brought these ideas home to Basalt Mountain in Central Colorado. There the basic design principles of permaculture systems took on different clothing:

- Diverse polycultures.
- Emphasis on perennials.
- Use of succession in both establishment and yield.
- Dense multi-story plantings (stacking).
- Little or no cultivation of soil.
- Using multi-functional plants, animals, and structures.
- Matching yields and needs of the elements in the system for mutual benefit, and most importantly.
- Close interaction between the resident/designer and the evolving system, based on observation.

Though little demonstrated in the cold climates, the forest garden has taken many forms throughout the tropics, especially in highland regions such as East Africa, Sumatra, Ecuador, Mexico and Guatemala, but also in the tropics of Malaysia, Java, and Kerala, India. Always a densely stacked polyculture of edible and useful species, the forest garden is characterized by a structure of seven cropping layers: canopy, mid-story, shrub, herb, ground cover, root, and vining verticals. Classically it has provided the basis of a subsistence economy for small farmers and villagers in which most, if not all household needs are met from the immediate environment. Plants are often kept together with animals, and both are closely managed.

Already familiar with intensive production in his year-round market garden, Jerome had created an infrastructure for his integrated greenhouse/garden production which later supported the rapid establishment of a forest garden.

The greenhouse and market garden occupied the main south and east facing slopes of Jerome's sheltered site at 7,200ft on Basalt Mountain, while just west of these in a small ravine below the house he had attempted to create an orchard over the years, planting some apples and apricots. Though some of the trees had taken hold, they hadn't flourished, and the mulch around their roots kept slipping away on the steep slopes, leaving the hillside under and around the young orchard barren and unusable when it emerged from the snow each spring.

Key to all that followed was the creation of appropriate earth-works in the form of stone terraces. Providing a rich variety of landforms increased the "edge" of the sloping ravine, while the stones added thermal mass which enhanced the microclimate of the partially shaded slopes. In this way, Jerome laid a foundation for the diverse abundance of plant species which now occupies the forest garden.

The clay soil of the little valley had been an inhospitable terrain for the annual garden plants, but it made a good subsoil base for trees when topped with 18″ to 24″ of course organic matter: spoiled hay, fallen leaves, unfinished compost material, and wood chips. These materials were piled in behind the terraces using sheet mulch techniques. Gypsum, which helped to lighten the alkaline clay subsoil and make calcium available in the beds, was added at the same time.

The stone terraces not only proved their worth by retaining organic matter on the slopes, they continue to serve multiple functions in the garden. Besides affording several critical degrees of frost protection (in a climate where frost can occur any month of the year) and enhancing fruit ripening, the stones provide ideal habitat for garden snakes which keep down both mice and slugs. The crevices between the stones have become a useful edge into which Jerome plants insectary species such as dill and cilantro.

By defining discrete planting areas, the rock walls lend themselves well to two important permaculture strategies: spot mulching and guilds. Each terrace becomes the site of one or more fruit trees supported by a host of beneficial companion plants. These "companeros," as Jerome calls them, include nitrogen fixers: Siberian pea shrubs, fava beans, clovers, alfalfa; aromatic and insectary plants such as fennel, celery, horseradish, garlic mustard, and walking onions; bee attractants like borage; medicinals such as sweet annie (artemesia sp), the native mullein, and purple coneflower; mulch plants, of which comfrey is the queen; and a raft of smaller edibles: bush cherries, elderberries, Jerusalem artichokes, peas, sunflowers, currants, and gooseberries. Besides enhancing overall yield, these smaller fruits and vegetables provide forage for the gardener making his periodic rounds to pluck weeds. Throughout the profuse growth, scarlet runner beans and squash meander, tall herbs lean over beds below, and grapes send their tendrils out in search of supporting branches.

Deep mulch, renewed annually in the autumn just before snowfall (which helps to moisten and hold it in place), ensures fertility and moisture in the beds. This is supported by drip irrigation, important insurance for the establishment phase in this dry climate. Nutrients in the mulch are supplemented with periodic thinnings from the garden, straw yard compost, and foliar sprays of seaweed, manure and comfrey teas. Undesirables such as pigweed (Amaranthus) and all annual crop

residues are tucked several inches under the mulch where they feed a happy crowd of earthworms, busily manuring the soil with their castings. In the dry mountain air, vegetable wastes left lying on the surface would oxidize without adding any nutrient to the soil. Tucking them under helps to close the energy cycle.

While the stone terraces defined the ground of the forest garden, stacking of taller elements on upper terraces (to avoid shading plants below) created the vertical dimension. Jerome incorporated large existing fir and juniper trees on the east-facing slope as canopy, adding in apricots and standard apples. Below these in the mid – story he planted plums, semi-dwarf apples, and mulberries. The shrub layer consists of bush cherries, elderberry, high bush cranberry, and caragana, while the herb layer is composed of perennial salad greens such as burnet and miner's lettuce, favas, dill, fennel, comfrey, and lovage. Leguminous ground covers such as fenugreek, birdsfoot trefoil, clovers, and alfalfa have proliferated. Below ground in the root zone, yields come from garlic, walking onions, and Jerusalem artichokes, while vining scarlet runner beans, squash, grapes, nasturtiums, and hops weave the whole together.

Seeing solutions, not problems

Jerome's design for the forest garden evolved from four to five years of struggle with a difficult site. Most of the problems he encountered had their roots in the view of elements in isolation. Conventional concepts of the orchard and salad garden were inadequate for the extremes of aridity, cold, slope, and variable weather which his Rocky Mountain location presented. To counter these daunting conditions he needed the synergy of beneficial plant, animal and structural assemblies. Only when he began thinking of the orchard and the elements within it in all their possible relations was he able to move toward solutions appropriate for his needs and his landscape.

Large and thorny problems defied hard work and persistence. The ravine and the existing orchard lay within the fenced zone of the homestead; they were of high value but low productivity. Steep slopes and clay soils resisted conventional mulching, while cultivation would have been disastrous. Terraces and deep mulch turned things around. The annual salad green operation, while financially successful, was too labor-intensive to maintain permanently. Its demands didn't mesh with the declining labor availability of Jerome's own human lifecycle. Perennials, no cultivation, and mulched pathways cut labor requirements dramatically. Permaculture courses and workshops were an integral part of Jerome's local economy, but the permaculture ideology of diversity and succession hadn't been tested on his ground. Today the forest garden strategy demonstrates permaculture in all its many dimensions.

Design and establishment were aided by working with guilds. A whole guild which was created on the deer fence (incorporating the structure) included hops, Russian olive, sweet peas, gooseberries, and garlic. Apples were planted with clover (a N-fixer) and borage which attracts bees, aiding fruit-set. Garlic, favas, dill (an insectary plant), native lupins, and wildflowers were added in. Under the existing fir, currant, caragana, salad burnet (a shade-tolerant perennial green), crotolaria, and frost-hardy marigolds, (which are effective against nematodes) contributed their different

strengths. The guild plantings both support tree establishment and create diversity from the beginning.

Planning for a succession of yields was as important as careful staging of the foundation to make most of high initial labor input. Jerome established his rootstocks in place the first year and concentrated on building soil. Early yields came from the production of annuals, while perennial and self-seeding companeros were gotten going. Volunteer plums (from composted kitchen waste as well as native species) were grafted in place to a variety of European plum scions. He continues to observe which varieties survive and propogates these. Adapting this rough strategy to other fruits, he has brought in selected rootstocks, later grafted in place from initial purchases of scionwood varieties as these reach bearing in their fourth year.

Heavy mulch greatly aids the young trees during the stress of transplant and root establishment. Soil moisture is supplemented by drip irrigation and spot composting, and all help build fertility. Umbels are easily reseeded as they mature by shaking ripe seed heads across the beds. When broadcast red clover volunteers elsewhere on the homestead, it is potted into the greenhouse and later transplanted into forest garden beds. Left to Fukuoka-style benign neglect, its cousin yellow clover has already become self-propagating throughout the garden.

Jerome has learned to locate elements for beneficial function. Mints and nasturtiums growing under the greenhouse eaves benefit from extra roofwater and at the same time they fumigate the greenhouse interior, repelling whitefly from the nearby intake vents. In ten years Jerome has had no whitefly problems in the greenhouse. Bee attractants in the same area ensures that pollinators do find their way inside. The chicken straw-yard adjacent to the forest garden yields copious quantities of composted manure for improving the terrace beds, while caragana is planted everywhere for use as mulch and fertilizer.

Determining the right combinations requires careful observation to reveal the microenvironmental conditions of each spot. The ravine into which the forest garden was planted was cool, but protected from frost by drainage. Sensitivity to solar access for all areas was essential. The addition of heat-loading stone to west-facing slopes made a large difference in the micro-climate of that side. The cooler east-facing slope was protected by an existing fir tree from settling frosts. Jerome left the tree and planted shade-tolerant berries and herbs below it.

Problem solving has become a habit! The integrated pest management strategies which Jerome employs stem directly from the diversity and multi-functional elements of the forest garden design. No one approach is expected to meet every need, but multiple strategies, diverse floral plantings, soap sprays, releases of beneficial insects, row covers, trap crops, attractants, and plant vigour from deep mulch all contribute to environmental balance with virtually no insect damage in the forest garden. While the deer fence controls predation by these creatures, smaller wildlife abound: squirrels ate the fava beans and rabbits were also a pest. An annual crop of cats, themselves controlled by local raptors, provided an effective response. Mice loved the mulch environment and sometimes girdled young trees, so it became necessary to keep mulch away from direct contact with the bark. Snakes and cats did their part too.

Other influences are less obvious but no less effective. Walking onions which reseed from bulb-lets at the top of their stalks walked around in the pockets of the gardeners spreading their beneficial influence through the orchard. Horseradish worked as a trap crop for grasshoppers. Though the leaves were ventilated, the roots were still harvestable. Comfrey, a fine source of mulch and a medicinal and food perennial, also wiped out quack-grass.

Diversity has both economic and unexpected benefits. The garden is easily maintained by "no work" methods. It provides a format for diversity, a context for medicinals and insectaries. The complexity creates niches for unique plants: fenugreek, various edible flowers, and uncommon fruits such as currants and gooseberries. Apples on dwarfing stocks permit a greater variety, including many antique and heritage cultivars, to occupy a small space while maintaining high yields. The apples give not only crop, but a generous supply of scion-wood for nursery stock and repeated opportunity for grafting workshops. They yield at four years instead of seven, the norm at this altitude. Fruits are smaller, but incredibly sweet, luscious, and flavorful. Salad vegetables grown in partial shade are more tender and succulent. Diversity is also pleasing to the eye, nose, and tastes. In a very short time the forest garden becomes the preferred environment for human inter-actors.

Putting the philosophy of maximum intelligence and minimum effort at the heart of the design, Jerome hangs in his hammock in a scrub oak copse near the center of the forest garden. From this observation point, he continually refines his work using subtle principles and small manipulations to guide the development of the garden now. Intelligent observation, select genetics, foliar nutrient sprays, aromatics, flowers, compost, and manure teas all work to enhance the health of the system. He adds that most plants which are healthy for the forest garden are healthy for humans as medicinals. Ultimately the highest-value yields of the forest garden are just such subtle and intelligent products as inspiration and refreshment, education, medicinals, tinctures, scion wood and seed, other propagating materials, and fertilizer teas.

In time, the forest garden takes over, and the designer becomes but one more element in it. Jerome plans to extend his terraces downslope to envelope a pond using forty tons of salvaged stone from construction excavating. Trellised grapes and espaliered apples are appearing in the original market garden now as the separate annual planting beds disappear, converted to perennial polycultures. The forest garden has become a self-seeding, self-maintaining system continually adjusted by observation, harvest, and small routine nutrient exchanges with the household/greenhouse/market garden. Orchestrating a perennial system proves the effectiveness of permaculture principles. It's fun!