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COURSE SCHEDULE

Daily start time 8.45am seated in auditorium ready for class
9.00am to 10.30am first lecture
10.30am to 11.00am Morning tea break
11.00am to 12.30pm second lecture
12.30pm to 1.30pm Lunch break
1.30pm to 2.30pm third lecture
2.30pm to 3.00pm Afternoon tea break
3.30pm to 5.00pm fourth lecture

The middle Sunday of the course is a day off.

We will assemble student work groups after the fourth day to work up on-ground designs with realistic design briefs to be presented as a group on the final day as a group of design consultants.

After the second day there will be shared slide shows, talks and open discussions in the evening's, one evening we will convene a "liars night" (tall or true stories), the final night is a compulsory party- everyone must sing, recite, mime, tumble or tell a story etc. Venue and times to be announced.

INTRODUCTION TO PERMACULTURE

Ethics

"Care of the Earth" – this includes all living and non-living things, land, water, animals, air etc.

"Care of People" - to promote self-reliance and community responsibility.

"Return of Surplus" – to pass on anything surplus to our needs (labour, money, information etc) for the aims above.

Implicit in the above is the "Life Ethic": all living organisms are not only means but ends. In addition to their instrumental value to humans and other living organisms, they have an intrinsic worth.

Permaculture is an ethical system, stressing positivism and cooperation.

Definition of Permaculture

Permaculture is the conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability and resilience of natural ecosystems. It is the harmonious integration of landscape and people providing their food, energy, shelter, and other material and non-material needs in a sustainable way. Without permanent agriculture there is no possibility of a stable social order.

Permaculture design is a system of assembling conceptual, material and strategic components in a pattern which functions to benefit life in all its forms.
The philosophy behind permaculture is one of working with, rather than against, nature; protracted and thoughtful observation rather than protracted and thoughtless action; of looking at systems in all their functions, rather than asking only one yield of them; and of allowing systems to demonstrate their own evolutions.

The word "permaculture" can be used by anybody adhering to the ethics and principles expressed herein. The only restriction on use is that of teaching; only graduates of a Permaculture Institute can teach "permaculture", and they adhere to agreed-on curricula developed by the College of Graduates of the Institutes of Permaculture.

Real World Design

The need for the establishment of sustainable systems globally is now obvious.

Sustainable systems:-

- Produce more energy than they consume.
- Create, or at the very least do not destroy soils and forests.
- Produce most of the regional needs.

- Recycle or produce nutrients.

Agricultural systems that can satisfy these criteria of sustainability:-

- Forestry.
- Ponds, lakes and paddy.
- Permanent pasture.
- No-tillage cropping and mulched systems.

The natural hierarchy of production per unit area in natural systems:-

- Mangroves and estuaries.
- Shallow lake and swamp systems.
- Forests.
- Shallow marine systems.
- Prairies and crops.

Permaculture is primarily a design for a sustainable, human-controlled support system.

- Polycultures of mixed systems and ecotones out produce per unit area any simplistic monocultures. Mixed plant/animal systems are part of a total polyculture.

Permaculture concentrates on already settled areas and agricultural lands, and almost all of these need drastic re-design and re-patterning. The result of redesign of food supply systems integrated throughout our settlements with fiber and fuel forests placed in a nearby zone and the establishment of water catchments from our settlement run off surfaces, will be to free most of the area of the globe for the rehabilitation of natural systems. These large natural systems need only be of use to people in terms of a very broad sense of global health. The real difference between a cultivated designed ecosystem and a natural system is that the great majority of species and biomass in a cultivated ecology is intended for human use or the use of their livestock.

Whether we approve or not, the world continually changes, commonsense tells us that all has changed, is changing and will change. In a world where we are losing forests, species, and whole ecosystems, there are three concurrent and parallel responses to the environment:-

1. Care for surviving natural assemblies and to leave the wilderness to heal itself.
2. Rehabilitate degraded or eroded land using complex pioneer species and long-term plant assemblies (trees, shrubs, ground covers)
3. Create our own complex living environment with as many species as we can save, or have need for, from wherever on earth they come.

The Prime Directive of Permaculture

The only ethical decision is to take responsibility for our own existence and that of our children:-

- We need to get our house and garden, our place of living, in order, so it supports us.

There is historical proof that within a region of environmental stability created by sustainable land use systems, stability in human population naturally occurs. If we do not get our cities, homes and gardens in order, so that they feed and shelter us, we must lay waste to all other natural systems and we become the final plague.

Permaculture as a design system contains nothing new. It arranges what was always there in a different way, so that it works to conserve energy or to generate more energy than it consumes. What is novel, and often overlooked, is that any system of total commonsense design for human communities is revolutionary.

Principles of Natural Systems and Design

Guiding principles of permaculture design:-

- Everything is connected to everything else.
- Every function is supported by many elements.
- Every element should serve many functions.

Design can be for aesthetic and functional purposes. Permaculture design concentrates on function.

Functional design is:-

1. Sustainable so it provides for its own needs.
2. Has good production, providing surplus, for this to occur, elements must have no product unused by other elements and have their own needs supplied by other elements in the system.

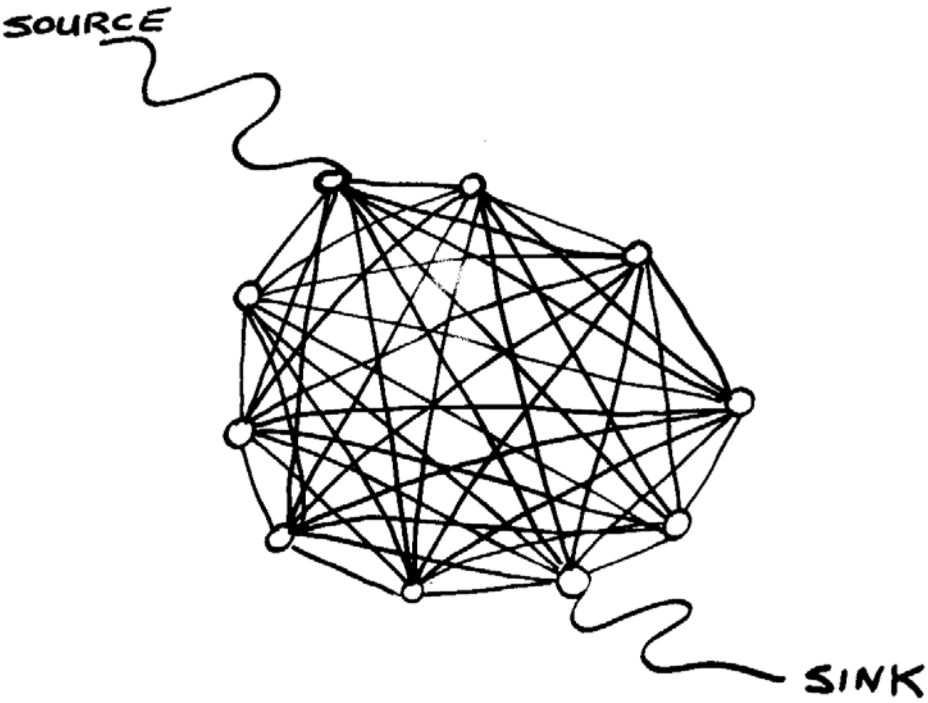
If these criteria are not met, then pollution and work result. Pollution is a product not used by something else; it is an over-abundance of a resource. Work results when there is a deficiency of resources, when an element in the system does not aid another element. Any system will become chaotic if it receives more resources than it can productively use.

A resource is any energy storage which assists yield. The work of the Permaculture designer is to maximize useful energy storages in any system on which they are working, be it a house, urban property, rural lands, or gardens. A successful design contains enough useful storage to serve the needs of people.

The web of life.

A net of functional relationships.

A design/ecosystem.



Full of potential energy.

This is Earth's system and net universal system of energy flow. Pathways through the net follow energy flows to useful life niches or storages available as yield.

Diversity is related to stability. It is not, however, the number of diverse elements you can pack into a system, but rather the number of useful connections you can make between these elements:-

- Inter-active diversity leads to stability.
- Stability leads to fertility.
- Fertility leads to designed sustainable productivity.
- Productivity leads to a designed sustainable economy.
- Economy leads to a designed sustainable and inter-active community.
- Permanence in culture results through inter-activity.

From source to sink:-

- Diversity increases.
- Energy stores increase.
- Organizational complexity increases.

Yield:-

Yield is the number of useful energy stores. It is the energy conserved, stored or generated within the system. Never is it just product yield (tons of grain per acre) but always a sum of storages. It is created by the complexity of the web we build which decides the number of useful storages. Yield can be defined as usefully stored energy, therefore, yield, is a function of design.

Methodology of Design

Permaculture design emphasizes patterning of landscape, function, and species assemblies.

It asks the question, "Where does this element go? How is best placed for maximum benefit in the system?"

Permaculture is made up of techniques and strategies:-

- Techniques are how we do things, (one-dimensional).
- Strategies are how and when, (two-dimensional).
- Design is patterning, (multi-dimensional).

Permaculture is all about the science and ethics of design patterning.

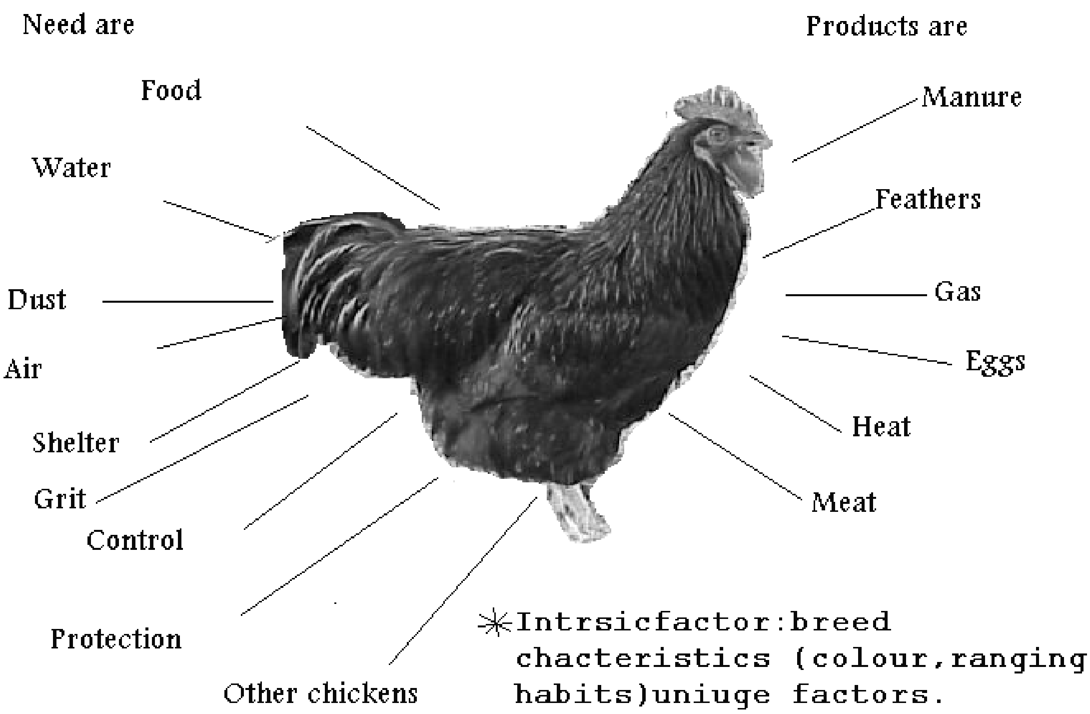
Approaches to design:-

1. Maps, "where is everything?"
2. Analysis of elements, "how do these things connect?"
3. Sector planning, "where do we put things?"
4. Observational.
5. Experiential.

1 - Maps: A main tool of a designer, but "the map is never the territory". Be careful not to design just from maps, no map tells the entire story that can be observed on the ground. A sequence of maps are valuable to see clearly where to place elements: - Water, Access, Structures, Topology etc.

2 - The analysis of elements: List the needs, products, and the intrinsic characteristics of each element. Lists are made to try and link the supply needs of elements to the production needs of others.

An example that is easy to understand is the lists needed to link a chicken into a system:



Experiment on paper, connecting and combining the elements (buildings, plants, animals, etc) to achieve no pollution (excess product), and minimum work. Try to have one element fulfill the needs of another.

3 - Sector planning: Includes (a) zones (b) sector (c) slope, and (d) orientation

A. ZONES, it is useful to consider the site as a series of zones, which can be concentric rings, a single pathway through the system, starting with the home centre and working out.
   The placement of elements in each zone depends on importance, priorities, and number of visits needed for each element, e.g. chicken house is visited every day, so it needs to be close (but not necessarily next to the house). A herb spiral would be next to the kitchen.

   Zone 1:

   - Home centre
   - Herbs, vegetable garden
   - Most built structures
   - Very intensive
   - Start at the backdoor

Zone 2:

- Intensive cultivation, main crop
- Heavily mulched orchard
- Well-maintained
- Mainly grafted and selected species
- Dense planting
- Use of stacking and storey system design
- Some animals: chickens, ducks, pigeon
- Multi-purpose walks: collect eggs , milk, distribute greens and scraps
- Cut animal forage

Zone 3:

- Connects to zone 1 and 2 for easy access
- May add goats, sheep, geese, bees, dairy cows
- Plant hardy trees and native species
- Un-grafted for later selection, later grafting
- Animal forage
- Self-forage systems: poultry forest etc
- Windbreaks, firebreaks
- Spot mulching, rough mulching
- Trees protected with cages, strip-fencing
- Nut tree forests

Zone 4:

- Long term development
- Timber for building
- Timber for firewood
- Mixed forestry systems
- Watering minimal
- Feeding minimal
- Some introduced animals: cattle, deer, pigs
- Zone 5:
- Uncultivated wilderness
- Re-growth area
- Timber
- Hunting

Species, elements, and strategies change in each zone.

B. SECTORS, the aim of sector planning is to channel external energies (wind, sun, fire) into or away from the system.

The zone and sector factors together regulate the placement of particular plant, animal species and structures.

C. SLOPE, placement of an element on slope so that gravity is used to maximum capacity:

- water storage
- mulch and other materials (kick down)
- cold air falls, warm air rises

D. ORIENTATION, placement of an element so that it faces sun-side or shade-side, depending on its function and needs.

4 - Observational: Free thinking or thematic thinking (e.g. on weed species)

a) Note phenomenon
b) Infer (make guesses)
c) Investigate (research)
d) Devise a strategy

5 - Experiential: Become conscious—of yourself, feelings, and environment. Can be free-conscious or thematically-conscious. Zazen—walking without thinking, unreflective.

PUTTING IT TOGETHER: Use all the methodologies of design.

Select elements – pattern assembly
Place elements – pattern relationship

<u>Brief Worldview of Permaculture</u> (what does it do and where?)

The planet is in crisis, the global ecological, food and water systems are all failing. Climate change is accelerating; Permaculture design offers positive solutions today. There are now 750,000 graduates of this course worldwide with over 400,000 projects in 120 countries. Permaculture design consultants are now recognized by the United Nations aid organizations and employed in both emergency and development aid projects.

Permaculture consultants are now used in regional development for environmentally sustainable design criteria demanded by local and national governments worldwide.

<u>What does this course do for you?</u>

Participants will gain a thorough understanding of sustainable land use design from the urban apartment to broad bio-regional catchments, eco-village design, effective and ethical financial systems, patterns in nature and their uses, climate factors, proven strategies for domestic food and water security, forests and how they work, large and small scale water catchments and treatment, proven design strategies from the sub arctic to the equatorial regions, effective aid work, education, effective earth works and repairs, dry lands and desert understanding and self sufficiency anywhere, and access to global networks.
This course is for full-time designers, working in groups or in teams. The functions of a designer is to know where things are to be placed and, in

particular, why they are to be placed there. A good designer relies on the number of elements available, information about elements, ability to use that information harmoniously, and the degree of success in comprehension. It is not necessary to know how to build or level or engineer or even garden. The designer should know when his job begins and ends, and where the role of a supervisor begins. Reading is necessary after the course ends, but essential planning data is given.

3 DVDs

CONCEPTS AND THEMES IN DESIGN

Laws, principles, concepts and themes
Conversion of a law to a directive

There are a great variety of natural laws and principles and as designers, we use these as active tools, literally directives to act, whereas those who discovered them did so as a result of a passive process of observation. The greatest difficulty we have as designers is in the intelligent local application of cosmic passive principles.

An axiom is either an established principle or a self-evident truth (sunrise in the east, sunset is in the west).

A principle is a basic truth, a rule of conduct, a law determining how something works.

A law is a statement of fact about the behavior of natural phenomena; it is supported by a set of hypotheses which have proved to be supportable or "correct".

A thesis is an idea which is offered up for proof or discussion.

A hypothesis is a statement which is testable by experiment; it is objective, testable and a priori before the test.

Many statements made by people are somewhat confused mixtures of the foregoing.

A rule is a discovered relationship, e.g. "as a rule" water flows at right angle to contour.

A directive is a way to proceed. It is an applied principle, and has an active component.

By examining several sets of rules, laws and principles we can establish a set of practical directives, principles by which we can act on design.

All designers should be aware of the fundamental laws that govern every natural system.

The overriding law is that:

The total energy of the universe is constant and the total entropy is constantly increasing.

Entropy is bound energy; it becomes unavailable for work, or not useful to the system. It is the waters of a mountain forest that has reached the sea, the heat, noise and exhaust smoke that an automobile emits while travelling, and the energy of food used to keep an animal warm, alive and mobile. In a sense, it is also disordered or opposing energy of contesting forces.

All energy entering an organism, population or ecosystem can be accounted for as energy which is stored or leaves. Energy can be transferred from one form to another, but it cannot disappear or be destroyed or created.

This is a restatement of the First Law of Thermodynamics.

Caloric book-keeping, energy budgets or energy audits are what measure the efficiency of a designed system. In today's society, gardens and farms, much non-harmonic energy is degraded to waste.

No energy conversion is ever completely efficient.

This is the second Law of Thermodynamics.

No matter how good a design is, and how complex the net we set up to catch energies before they are bound, or to slow the increase in entropy, when it comes to the universal equation, we must lose. The only question really is "how much need we lose of incoming or released energy?" and how much can we usefully store?

1. Nothing in nature grows forever.
2. Continuation of life depends on the maintenance of the global bio-geochemical cycles of essential elements, in particular, C, O, N, S and P.
3. The probability of extinction of populations of a species is greatest when the density is very high or very low.
4. The chance that a species has to survive and reproduce is dependant primarily upon one or two key factors in the complex web of relationships of the organism to its environment.

The Over-run Thesis

5. Our ability to change the face of the of the Earth increase at a faster rate than our ability to foresee the consequences of change.

The Life Ethic Thesis

6. Living organisms are not only means but ends. In addition to their instrumental value to humans and other living organisms, they have an intrinsic worth.

Although these laws are basic, inescapable and immutable, what we as designers have to deal with are the here and now of survival on Earth. We must study whether the resources and energy consumed derive from renewable or non-renewable resources and how non-renewable resources can best be used to conserve and generate energy in living (renewable) systems.

Fortunately for us, the very long-term energy derived from the Sun is available on Earth and can be used to renew resources if life systems are carefully constructed and preserved.

There are several practical design considerations to observe:

- The systems we construct should last as long as possible and take least possible energy to maintain.
- These systems fuelled by the Sun, should produce not only for their own needs, but also the needs of the people creating and maintaining them. A system is sustainable if it produces more energy than it consumes, at least enough in surplus to maintain and replace itself over its lifetime. A well design system achieves this, and a large surplus of production over and above this basic requirement of sustainability.
- We can use energy to construct these systems, providing that in their lifetime, they store or conserve more energy than we use to construct and maintain them.

Resources, Their Nature and Management:

- Matter
- Energy
- Space
- Time
- Diversity

Are all categories of resources and these are constant universal principles.

- Food
- Climate
- Habitat
- Plants
- Animals

These are the basic resources affecting plant and animal populations. Resources are things thought of as of use to us, and enable us to utilize energy more efficiently.

A resource is anything available to an organism, population, or ecosystem which up to an optimum level allows an increasing rate of energy exchange.

However we need to look at life systems as a whole in order to see that there are several categories of resources and the use of some decrease the availability of others, over-use of parts of the general resource base by a species or individual decreases the diversity and or vitality of the whole system.

Definition of resource use effect:

- Increase if used (browse)
- Not affected by use (time)

- Decrease if not used (annuals)
- Need management to be maintained (forests)
- Decrease if used (fossil fuels, deep aquifers)
- Decrease other resources if used (uranium, biocides)

All these to some extent are affected by wise or unwise management. All except time and diversity, have an optimum amount which can be stacked into a system beyond which there is either no increase in yield, or a decrease in yield.

However the number of possible life niches in a designed system has no fixed value, there is no limit to richness.

The principle of Chaos and disorder.

If resources are added beyond the capacity of the system to use them, then that system becomes disordered and goes into chaos.

Chaos or disorder is the opposite of harmony, as competition is opposite of cooperation. In disorder, much useful energy is cancelled out by the use of opposing energy, thus creating entropy or bound energy.

Society, gardens, whole systems and human lives are wasted in disorder and opposition. The aim of the designer is therefore two-fold:-

- To use only that amount of energy that can be productively absorbed by the system.
- To build harmony, as cooperation, into the functional organization of the system.

Do not confuse order with tidiness, because tidiness is usually disordered in the life sense.

1- 2 DVDs

PATTERN UNDERSTANDING

Traditional uses
Revelation, seeing in one example 1000 questions

The universe is a series of events, most are similar in form, as the core model (apple core). Tessellation in connected form of two core models form the earth as the oceans and land masses or the simpler pattern of a tennis ball. Section of the core model demonstrate many recognizable patterns we see every day in the natural environment. Events evolve patterns because it is the most efficient way to grow. There are two classes of events one organic typified by seeds as growth patterns, and one inorganic atomic and typified by explosions and impacts (craters and shatters) like the pattern of the atomic bomb explosion, but they are both very similar in form.

Orders of all things.

Traditional uses of pattern by people:

- Critical in navigation in seas and deserts alike.
- Sagas and genealogy.
- Timing of events, and therefore prediction.

Patterns are information dense, as teaching systems.

Pattern understanding, and pattern teaching (stone boat, bure')

Pattern applications, and how to apply pattern knowledge in design. Design in a sense is good application of pattern or the sophisticated application of patterning.

DVDs

CLIMATE AND CLASSIC LANDSCAPE PROFILES

Humid, arid and continental climates
Volcanic, islands high and low, coasts, flatlands, wetlands. Arid, dunes, basement and erg.

<u>Climate Differences</u>

As a designer we must have a very clear understanding of exactly which climate we are working in, and the possible fluctuations within that climate zone.

Three basic divisions Cold/hot/dry or Temperate/tropical/Arid plus continental climate which are a long way inland.

Temperate has wet winters and dry summers, topsoil is usually deep and contains nutrients and elements and cultivation is cautiously possible on contour in small area fields. Mulch naturally develops with the yearly flush annual herbs and deciduous tree leaves adding to the soil ever autumn. Small areas should be mulched, larger areas cut/grazed in cycles. The amount of humus in the soil determines the fertility. Fields need to be small with deep-rooted deciduous trees to ensure nutrient cycling plus new nutrient deposits. The best strategy for cropping is no tillage systems of overlapping crops winter to summer, each crop mulched by the previous crop residue. Winter is often a dormant period with little if any growth and sterilization of the soil. The spring breaks into a great flush of herbaceous growth, which makes up most of the summer fresh cut mulch with the previous autumns composted leaf fall. At the extremes of the main temperate climate zones of Earth we have the Sub-Artic with permafrost, through to cold temperate, cool temperate, warm temperate what is called a Mediterranean climate.

Tropical zones have wet summers and dry winters. The topsoil's are usually thin and most nutrients 80-90% held in suspension above the soil in life systems mainly plants. Plow agriculture is a disaster and usually a quick failure. Very little mulch develops under the forest, as decomposition is continuous and fungi action rapid. Biomass (plant and animal mass) is crucial to stability of landscape and fertility of soils. Bare soil leads to the development of caliches, concrete-like layers below the soil and severe erosion results with heavy tropical rains. Nitrogenous ground covers are an essential precursor to agriculture summer ground covers and winter ground covers until nitrogenous pioneer tree cover is established and is shading the majority of the soil. Eventually establishing 4-6 large long-lived uncut leguminous trees to the acre, the smaller nitrogenous trees then being pollarded for continuous branch, twig, leaf and seed pod mulch to the soil, as an in crop nutrient recycling strategy. It is essential to cut the woody mulch required in the tropics starting at the beginning of the wet season in summer and stopping well before end of summer. The re-growth of the pollarded tree inter crop provides essential partial shade for the dry season crops when water stress is at the highest. Dry periods and water competition during establishment may be solved by the use of drip irrigation, and selective small animal grazing in advanced tree crops. It is essential to incorporate as much tree crop as possible; otherwise aquaculture and paddy crop where nutrients are bound up in algae and mud. At the extremes of the tropics we have the sub-tropics through to dry tropics (which are part the arid zone), wet-dry tropics and the equatorial wet tropics.

Arid zones have much greater annual evaporation rate than rainfall, the rains come in just a few quick large intense events usually in mid winter. Soils usually contain plenty of nutrients but need humus and water to be released. The concentration must be on increasing soil life cycles with plants cycles that decrease evaporation through shade, wind buffering and mulch additions which in turn increases the efficiency of the water cycles as all these are crucial for establishment in an arid environment. Desert strategies primarily are all about reducing evaporation, which means they are water-connected. Great attention and detail must be paid to wastewater in mulched home gardens, flood flow during the few large yearly events and runoff from all hard surfaces natural or manmade. Deep rooted pioneer trees need mulch and drip irrigation in establishment for shading, wind buffering leading to mulch production when established that can be can and added to for crops and fruit trees. At the first rains of winter most tree mulch is cut allowing plenty of time for re-growth for summer shaded. Summer is the slow period of the year where often heat and water stress are extreme. Fertilizer additions are mainly made during the winter months in milder time of year.

The major arid zone deserts of Earth are in the sub-tropics at the extreme end of the path of the vertical sun, the Tropic of Capricorn at latitude 23 south and Tropic of Cancer at latitude 23 north. There are cold and hot arid zone occurring at high altitudes through to lowest landscapes on Earth at 400 meters below sea level.

Continental climates are influenced by their geographic position being a large distance from the moderating effect of an ocean. Typical effects are a large variation between high summer temperatures and low winter temperature. The main usual come at the change of season spring and autumn.

Orthographic effects are common where climate is distorted by landscape form; these effects can be quite dramatic and will always need to be taken into consideration.

Ecosystems are climate moderators stabilizing the global weather systems. With the majority of the Earths ecosystems removed and the remainder under severe imminent threat of destruction, the global climate has become unstable and erratic. We are now experiencing a global climate system out of sync, with the hottest, coldest, wettest, driest, windiest event possible everywhere at once at any time of the year, possibly the fastest extreme rapid climate change ever. In this situation, we need more than ever before to be able to design and implement agriculturally productive ecosystems, which have the diversity, stability, resilience and flexible dynamics of natural ecosystems.

The Humid Landscape:

Humid landscapes of the tropic or temperate are gently rounded due to the forces of regular water on the substrate. This classic profile decides our whole strategy in water, structural and access placements, forests, soils, frost, fire and crops.

High points:

These are collection areas for rain, mists and humid air. Wide bald ridges can make good grazing country but narrow steep ridges should always be forested. Collection of water is possible with ridge point, plateau edge and saddle dams, with extra water harvesting features of swales these work extremely well.

Upper Slopes:

Instability of soils if greater than 18 degree slope or less in fragile soils is cleared of forest. Forest is the stabilizing mechanism for steep slopes and fragile soils. Forest work as warming systems for cold air flows. Water collection in plateau or contour dams is possible in the appropriate landscape profile.

Key Point:

This is a critical water point for lower slope irrigation and occurs near the top of <u>all</u> valleys in the humid landscape. Diversion drain can run into the key point, swales can run out to the ridges from the key point. Cultivation possible below the key point, water is clean above the key point and can be soiled with organic material below, beneficial for fertilization through irrigation. Housing is best suited to below the key point with forest above.

Lower Slopes:

Suited to mixed cultivation poly-culture. Terra forms make include terraces or mini-terraces.

Treatment of Individual Slopes:

Steep slopes with hard degraded soils or stones can be recovered using a net and pan small earth works and pioneer tree planting system.

Steep grassy slopes can be forested with pioneer trees using well mulch planting shelves. Small animal free ranged cycled through as required speeds up the process.

Very steep slopes are only possible to cultivate with very accurately constructed classical intensive terrace. Fire control needs careful design. Mini-catchments can be defined and capture to establish pioneer trees to stabilize slopes.

Flatlands:

Gravity irrigation techniques are usually passive with low head pressure and they need careful planning. Check dams back up a low head of water, as a great asset for irrigation in flat lands. Mulch is essential for growing systems and establishes pioneer tree windbreaks which can latter be themselves become mulch producers, and protection for crops and fruit trees. Swales on the flat country intercept run-off water which builds up local ground water reducing the need for extra irrigation. Earth banks add extra form, features and functions to the flat landscape.

The Arid Landscape:

An important desert strategy is to have many little systems going at once, all design to catch and store water. Water must be stored <u>in</u> the ground or <u>underground</u> away from the evaporation of the Sun. The placement of human habitation in relation to access to water, shade and cooling effects of winds all need careful consideration. Shade and shade houses are extremely value attachments to structures for comfortable living environments. All wastewater should be directed underneath mulch in home gardens for production and evaporation efficiency. Animal housing needs to be situated so that accurate control of their manure and its flow through the system can be achieved. Check dams across seasonal flows of water allow for flood flow irrigation, and low swale earth banks soak water into landscape. Mulch traps on water flow, and is also trapped by windbreaks as they comb the airflows of fine soils and organic matter. Roads and all man made hard surfaces need to be designed to direct run-off water for productive purposes. In stone deserts stone swales and earth backed stone swales hold back run off water long enough to soak in and create freshwater lenses in soils. Rock gabion dam walls leak water through but back fill with silt, which holds water and stays wet for long periods after rains. They also stop the movement of rocks and boulders which pile up at the top end of the silt pool unable to roll across the level surface. Woven baskets and large cardboard boxes can be used to plant trees deep in sand dunes, where sufficient moisture for growth is usually found one meter down.

Landscape features of the desert are numerous especially erosion forms which are very conspicuous and significant. The true desert has a broad classification of Erg sandy desert, sand plains with several types of dunes, Hamada rock and boulder pavement, and Reg gravel surfaces where sand and silt have been removed. Generally the desert landscape is distinctly angular and actively eroding.

<u>Scarps and wadis</u> feature long vertical cliffs with angular (usually 30 degrees) pediments at their base rise out of the lower erosion surface below, often called the peneplain. The wadis emerge out of the scarp cliffs face at right angle and branch at near right angles further up inside the wadis. Water is often trapped in scour holes at top of scarp cliffs, water can also be store in deep sands and silts especially if gabion dams are built inside wadis where increased shade extends storage time. These complex landscapes can have traditional been

well designed for comfortable productive human settlements. kopje, mesas and buttes are all features of this landscape.

Residuals, domes and inselbergs are simple systems of large individual rocks like Uluru (Ayres Rock) in Australia and large solid rock ranges. These all have guaranteed rainwater runoff which when it is captured can be carefully directed to production systems. Rarely do these have caves or pronounced valleys of any depth.

Fold Mountains are the most extensive features of deserts and combine features of both inselbergs and scarps, and are generally more complex. The folds are either synclines down-flexed or anticlines up-flexed, which commonly erode to form long river valleys. Many opportunities exist for designing dams and large dams are possible with extreme caution, the preference being many small dams accumulating the same volume of water and more. Swales and controlled contour flows of water off high valley stream lines to small dams can become the start of a totally designed and patterned landscape.

Dune country occurs over pavements or as dune fields all shaped by wind. The smallest shapes being ripples, Traverse dunes and regular ridges, Oblique dunes, Longitudinal dunes aligned with the wind, Bachans crescents pointing down wind, sand seas with of wave-like forms, Ergs are giant sand ridge lines, Draas are the largest form as a stationary small mountain of sand. Pitting, seed pellets, planting baskets, mulch mats, woven fences and even the spraying of tar oils can be used to stabilize and re-vegetate typical sand dune country.

Depressions and basins low flat areas or nearly circular depressions on a large scale are called tectonic basins and on the next scale down deflection hollows. Scalds are the name given to clay pans where water flows in and fills the area seals and the water flows out the lower side. Very low soft earth banks graded up on the lower side will hold back large amounts of floodwater, which when soaked in will be enough to plant up and recover the area.

Claypans fill in rains and rarely over flow allowing seasonal swamp type vegetation and animal habitat. Earth banks to hold back more water, ripping, pitting, seeding the claypan floor in the dry season will allow a diverse productive system to be developed. The establishment of herbs and needle-leaf mulch species will enhance establishment.

Saltpans and salt lakes hold meters of water in floods and when the water evaporate huge quantities of salt are left behind. Only on the margins will salt tolerant plants grow.

Gilgais are small hollows 3-5 meters across formed by patches of clay, which swell and shrink in depth with rain. The hollows can be linked up and the whole area becomes very diverse in plant species. If these are over grazed they become sand filled the clay washes away and small sand mounds appear the area becomes unstable and loses most of its vegetation.

Flood-outs, gullies and badlands are also called flat-outs or run-outs, ever widening close to flat floors of valleys as they leave hills. These streams are very shallow, wide and stable and water absorbs over a wide area of plains. The overgrazing of these leads to occurrence of severe steep side gully erosion.

Diversion of water flow from the head of the erosion gullies to diversion channels and out over long level sill spillways with pioneer tree planting. It is crucial to stop over grazing and prevent further cutting back of the gullies. Slopes on either side of erosion gullies can be ripped at 1000-1 slope down hill away to the ridge lines. Inside the gullies frequent series of low silt trap gabions can be constructed to grow pioneer trees and latter fruit trees.

Stone gibber desert cover large areas where the stones were once part of the soil structure but constant wind erosion has blown away the soil leaving the stones exposed. Stone swale banks loose piled on contour every 10-20 meters soak in large amounts of run-off making it possible to plant pioneer tree lines. The tree lines greatly reduce wind erosion and combing the air for small soil and organic particles. Swale trenches can be excavated just up hill from each stone swale bank to increase the effect of water infiltration increasing tree growth.

Once trees are established the inter-swale area can planted to crops.
Lower foothills and plains even land that looks completely flat to the human eye has some slope and water can be harvested with very shallow swales. Swale bank just half a meter high can back up water for a huge distance and this can mulch species be seeded once water soaks in our pelleted seed spread to wait for rain. So much water can be harvested that some water can be released with controlled slide gates to soak a smaller walled field to grow a crop. If remnant species of trees remain, semi circular swales can be sited around the lower side of these, which will capture the tree seed, organic material, manures and soak in rainwater run off, these can be connected in group or series to totally prevent run-off. Most of these low swale bank quickly establish volunteer local tree and shrub species.

Minor Landscape: volcanic, high and low island, coasts, wetlands and estuaries.

Volcanic:

Volcanic slopes have a repeated angle of repose which 64 degrees; this steepness needs careful application of design to retain stability. The traditional Ohana system achieved this with long wedge shaped village lands designed and maintained from forested top slopes down through multiple mixed systems to the beach, and out onto the coral reefs. Soils are usually rich and large ranges of crops are possible. There are two types of lava pahoehoe rock lava only good for 100% run off, and u’u which is like pumice, soft with many small holes, and this can be planted by digging mulch pits.

High Islands:

High islands are mostly granite or basalt with rich in flora and fauna with a humid to arid aspects. It is important therefore to study winds and rainfall carefully. Keyline system water design with ridge dams and terraces are all possible in these landscapes often. Lagoon catchments and shorelines are valuable assets to designing sustainable systems. Special problems can be cyclones, tsunami, earthquake, mudflow, lava flow, cinder flow and volcanisms.

Low Islands:

These are usually quite arid and need very serious attention windbreak design and planting, with all foreshores planted as winds are bi-modal. On coral islands, all rainwater soaks into the freshwater lens through the platin layer and this lens water cannot be pumped depleted of polluted. Swales do not work and mulch pits and deep pit gardens close to the lens are the only possible system, these are the traditional system of these islands. Dry compost toilets are the only none pollutant system especially where over population has caused problems with the traditional system of using the beach below high tide.

Coasts:

Coast always need frontline windbreaks of salt-resistant, waxy or needle leaf, sand-blast species with thick and fibrous bark. The alkaline beach sand needs humus and soluble sulphates and oxides offset the alkalinity, deficiencies in zinc, copper and iron (non-soluble in alkaline) are common. When establishing plants in sand, sawdust and paper lower p.H. and hold moisture, planting in woven baskets and large cardboard boxes are good techniques.

Wetlands:

Marshes and wetlands support rich yields of edible plants, shellfish, fish, water fowl and honey producing species.
The Chinampa system is recorded as the worlds most production sustainable agriculture. A pattern often of 50% land and 50% canals, it uses banks next to the water to maximize the productive edge in a system of water-land nutrient exchange in harmonic effect. Swampy and marshy land is ideal for this type of development. Ducks are the main livestock and they cycle nutrients, returning potash to the water and the land. Fish are marginal edge feeders and are well supplied, crustaceans, shellfish and edible emergent plants are all possible. Floating water plants, grow fast, filter suspended nutrient, some harvest nitrogen and can be mulched on to the land, as water holding, seed free, fertilizing mulch. With trellised crop over the water space is saved, fences are incorporated, and harvest can be by a small boat with the water supporting the weight of the harvest while boating. Occasionally canals are be drained and nitrogen rich mud scooped onto the banks.

Estuaries:

Estuaries are rich species areas with shellfish, fish, water fowl and many types of sea-grass useful for mulch, fodder and insulation. Fish traps, fish farms, shellfish farms, sea grass harvest and enhanced habitat and mulch traps can all be design as sustainable.

1 – 2 DVDs

TREES AND THEIR ENERGY TRANSACTIONS

Trees should be considered as energy transducers of; Wind, Sun and Rainfall.

Wind:

Only 40% of the wind is forced through the trees, and friction causes heat inside the forest with no frost in marginal frost sites. The trees on the outside have thicker trunks due to wind force and the inner trunks are thinner. The wind brings in dust and insects which fallout so the forest at the wind edge receives more fertilizer. Rain runoff is also more plentiful at the windward edge as the high pressure of the wind keeps the moisture in. The remaining 60% of the wind is forced up over the trees, forms and falls as Ekman spirals. Rain is caused by the Ekman spirals if there is any moisture in the air. Trees can cause moisture the moisture to drop because of the upward forced spiraling of the wind.

Light:

Light is absorbed, transmitted through or reflected by the tree, depending on trunk colour, leaf shape and colour, and canopy also this depends on climate. Light absorption is mainly on the crown for photosynthesis. A high light absorption tree is a radiator of heat and is mainly found in cool temperate climates.

Light reflection is also on the crown especially in dense plantings, and all over the tree in the form of silver leaves. A reflecting tree is a light producer and is usually found in low light conditions. Trees with white bark reflect heat away from the trunk. Transmitted light is red light, and stimulates root growth.

Rain:

Impact on the crown causes some immediate evaporation but in dense plantings, there is no impact on the ground, and so prevents erosion under the trees. Each leaf is wetted and no water falls through the crown until all leaves are wet, so the tree intercepts the rain. When through fall occurs water begins to drip off the leaves, towards the branches and trunk, this water is full of dust, insects and plant nutrients. Canopy drip-feeds the surface roots and trunk drip feeds the deeper tap root systems. The main function of the tap roots are to mine minerals which are brought back up to the leaves, and then washed off during rain to be used by the surface feeding roots. Leaf mulch litter under the tree impedes water absorption, and 3 inches of mulch holds 1 inch of water. The surface tree roots are able to absorb what they need before the water infiltrates to the ground. Infiltration takes place when all the soil crumbs are coated with water, and tree roots can soak water from the soil crumbs themselves. When the soil reaches field capacity or saturation point, water then slowly percolates to the groundwater. Transpiration occurs when the process reverses from deep[ground waters, goes back up through the trees and are released into the air as clouds. After the first rainfall on the land of 100% moisture from the ocean, 60% of all clouds inland are formed by forests.

The minute particles that rise off the trees is made up of bits of leaves, pollen, oils and waxes that exude off the leaves, and two types of bacteria that live with all this material on the leaves. At the center of every raindrop inland is a dust and bacteria nucleus particle off trees. More water that comes to Earth is condensation rather than rain. One tree can be as much as 20-40 acres of leaf surface area that can inter-act which humidity in the air. Moisture is condensed at night because it is relatively cooler than the air or wind. Trees put out negative ions which attract positive ions, usually dust and pollution, so air around trees is healthier. There is a great need for more trees throughout cities to counteract positive ions in the air, which cause depression. In 100% forest cover ground water run off is zero. At 80% vegetative cover; 5% runoff; at 60% cover; 35% runoff; at 20% cover; 60% runoff. Severe soil loss as vegetation cover is removed.

Types of forest:

Fuel – Forage – Structural – Shelter; animal barrier – Food – Natural – Conservation

Fuel:

It is essential that least use is made of solid fuels, barks and leaves should be returned to the soil or the system will degrade. Liquid fuels from species yielding sugars for conversion to alcohol, or directly to fuel mean the cultivation of permanent trees. Solid fuels can be harvested from pine cones, fallen wood, thinning, and short term pioneer soil creation and nitrogen fixing fast growing trees. Gas fuels from coppicing systems for conversion of biomass via composting for methane production.

Food:

Food forests of multiple mixed species, mixed in type, size, height, shade tolerance and layers, with support species inter-planted for mulch, nitrogen fixation, nutrient cycling, vine support, edge extension and control. Established with well prepared ground mass planted to pioneer plants and trees of different potential life spans, most giving way to fruit trees in the initial years of establishment. Food forests vary greatly to climate and somewhat to landscape profiles and soils. These are exciting, highly productive systems that are one of the main imprints of a bioregions identity.

Forage:

Forage can be designed into zones 2, 3, and 4 for small and large livestock, this greatly reduces the pressure on grass pasture. Livestock will eat, leaves, fruits and nuts off trees but most trees will need to be fenced off or allowed to grow large enough before livestock are put in. There also many trees that drop seeds, fruits, pods and leaves that can be eaten off the ground. There are also bee forage and fungi forage forests that we can design.

Shelterbelt and barrier:

Well designed shelter for animals and as protection for crops means we can put 20% of the area shelter without loss of production and gain the long term yield of the shelter belt itself.

Species can be selected that provide forage, shelter and act as a permanent barrier hedge. Windbreaks around the house, farm or settlement can greatly reduce energy costs.

Structural:

An enormous diversity of structural forest species exist in any one location and short and long term yield cycles. Inter-active mixed species assemblies can be design for endlessly sustainable productive forest systems. Uses can be round poles, sawn timber, industrial cellulose yield and craft uses.

Natural and conservation:

Forests have an intrinsic worth, beauty, wildlife habitat, creators of oxygen,, clean water supply, rain and moisture, soil, prevent erosion, deflect winds, and bring nutrients up from the ground.

Establishment of forest:

Select the species of use fuel, food, forage etc and design for placement, crown bearers and flower bearers on the outside of the clump, stem bearers inside.
Pioneers species can establish the essential conditions for forest by nitrogen fixation and nutrient build up on poor soils.

Pioneers can be time stacked some dieing out in 5, 7, 10 or 15 years, with a small percentage of support species growing on with the system to cycle nutrient over the long term.

It is important to establish trees in a clump fed by several drip points if necessary, as a clump of trees planted together support one another. Individual tree take up a lot more maintenance per tree, suffer water stress, wind pruned and smothered in grass.

Forest management:

Thinning – Coppice – Selection – Fire – Standards – Nutrients

2 DVDs

WATER

Water earthworks

Water is a rare mineral, in the form of potable water, water that is safe to drink and found naturally. It is the world most critical resource. Fresh water is only 3% of all water on Earth the rest is salt water in the oceans.

Of the fresh water:

75% - Ice sheets and glaciers

11% - Available ground water, less than 800m

14% - Deep groundwater and aquifers 800 to 4000m

100%+ or - the remainder is so small it is nearly insignificant.

0.3% - Lakes and ponds at the surface

0.06% - Soil moisture and forests

0.03% - Rivers

0.035% - Atmosphere

These are the storages we can influence locally.

The duties of water:

1. To procreate life in growing systems.
2. To develop productive aquaculture systems.
3. To develop hydraulic uses for energy production, pumping water, generating electricity and mechanical take-off.

The idea is to use water as many times as possible before it
passes through the system. Increasing life in a system increases potential yield.

In particular we can:

- Increase surface storage
- Reduce runoff
- Decrease evaporation

The essential techniques are:

- Increase soil storage by rehabilitation of compressed and sealed soils, using Keyline methods, including chisel plowing for increase aeration.

- Increase the soakage to high groundwater by excavating swales. A water harvesting channel on contour with a soft mound on the lower side made from the excavated material from the channel. Water is held momentarily from running away rapidly downhill and soaks in, trees planted either side will thrive. Water eventually slowly recharges ground water. Swales can vary in size up to 6m across the channel, depending on the size of the size and type of catchment.
- Reduce evaporation by mulching, which is an imitation of the forest floor leaf litter, preventing erosion and building up soils. This is easy to achieve in a small area, but over a large area mulch trees and shrubs need to be grown to produce surplus harvestable mulch.
- Increase small surface storages in the form of dams, ponds, small ponds in gardens, and tanks at houses for freshwater supplies.

Dams:

Types of dams need to be well understood;

Saddle dams position on a ridge between high points with 2 dam walls and fed by diversion drains and or swales. Very high positions possible as gravity irrigation dam.

Ridge dam positioned on a flatter spot on a ridge and fed by diversion drains and or swales. Usually a rounded crescent shape wrapped around the ridge, and curved dam wall, and high positions possible as a gravity irrigation dam.

Key point dam the highest possible valley dam in any one valley, can be fed by diversion drains, often connects to other key point dams at the same corresponding contour with swales. Connections to ridge point dams are possible. A key point dam is usually a high gravity irrigation dam.

Valley dams are the usual dams in the landscape with the dam wall crossing a valley. They are the hardest to build and take the most maintenance. The further down a valley they are situated the bigger they usually get, the spillway always gets larger the further down the valley they are positioned because the total catchments area has increased. These dams make good life dams and edge feature dams, and can be used for flood irrigation.

Contour dams positioned on shallow slopes fed by swales at the back with swale integrated spillways. These can be good aquaculture dams as they are easily shaped and can be set up to be easily drained.

An ideal landscape would have 15%+ covered with dams and cater for this water with swales and ripped conditioned topsoil, then planted along swales. We should try to hold water as high as possible.

A strategy of water use in landscape is the longest path over the most time with the most passive friction is the most fertile.

Evaporation strategy:

Instead of one big dam, construct 3 smaller dams, one above the other. Use the top dam first till half empty, then use the second dam until half empty and then fill the second dam from the top dam, then use the second dam until half empty and the do the same with the third. This cuts the evaporation rate.

Large completely enclosed in ground roofed tanks can be used to collect water efficiently in deserts.
Most runoff occurs from sealed surfaces like roofs and roads.

Irrigation systems:

- Drip or trickle, especially in dry land situations.
- Flood irrigation.
- Under canopy.
- Sprinklers, are not efficient and build up salt in the soil in dry land situations.

Components of irrigation system:

- Water source, bores, springs, soaks, runoff, swales, pipelines, creeks, tanks and lakes.
- Energy source, water at head pressure, pressure pumps electric, fuel, wind, hand or animal.
- Distribution network, net and pan, pipes, channels and buckets.
- Emitters, dripline, sprinkler and buckets.

Irrigation rules for arid regions:

- Irrigation under mulch to reduce salt problems and increase evaporation efficiency.
- Irrigate at dusk or at night if possible.
- Give long watering every 3 to 5 days, takes water down the trees roots are bigger in the cool of the soil and reduces leaching.
- Allow for leaching.

Waste water:

Biological cleaning systems incorporating plants that grow with their roots in water, anaerobic root systems can be design clean up all our polluted waste water we need create. Gravel reed bed systems where algae attached to the gravel assist in the cleaning process, aquatic plant pond filters, floating aquatic plant garden filters, water snails and compost worm farm filters can all be incorporated. Discharge water can go onto non-food forest, nut crop, essential oils and bamboos. Biologically cleaned grey water can be piped to mulched gardens or by root level drains below paths in food gardens.

In cold frosty climates these biological waste water cleaning need to be cover with a glass house to function in winter. All these biological cleaning systems create surplus high carbon material, which needs to be harvested and processed into humus through a decomposition cycle. It is in this surplus high carbon material that the toxins are trapped, and during the next stage, the decomposition cycle they become bonded to the carbon molecules and inert. Carbon is the life element, which can soak up our waste toxins and plants are a direct creative carbon pathway from the Sun and it's free energy.

Water is the great global solvent, carrier of nutrient or toxin, creator of life or main erosion element of systems.

2 – 3 DVDs

SOILS

Difficult soils

Soil Erosion the Number One Global Problem

Despite all our knowledge, in spite of soil services and soil analysis, and despite the best attempts of people to care for land, we are losing topsoil at an ever-increasing rate. Most counties of the world where extractive agriculture and forestry occurs have at best only 30% of their original soils in fair condition. With 70% having washed or blown away, or sadly depleted in structure and yield. This is mostly created by government subsidized unsustainable highly productive, chemical agriculture which is very profitable and very short term, regardless of the long-term cost of destroying our world for future generations.

The only places where soils are conserved or increased are:

- In uncut forests.
- Under the quiet waters of lakes and ponds.
- In prairies and meadows of permanent plants.
- Where we grow plants with mulched or non-tillage systems.

Parts Hydrogen = p.H

We need to understand the acid/alkaline analysis and interpret the consequence.

Compost and the decomposition cycle of humus creation is a process that needs to be understood.

Creation of humus in soil, can be achieved through additions of mulch, compost, animal skins and bones, etc etc. It may take 2 to 4 years to build a really good garden soil. Humus solves the problems of too much acid or too much alkaline.

The function of the hair roots of plants feeding on minerals and structuring soil with starch exchange.

Locally we can:

- Mulch and add nutrient for humus.
- Add seaweed, sodium salts or plant gels for water retention.
- Add bacterial activators for living additions.
- Plant legume trees for nitrogen fixation and phosphate harvesting trees for on-going fertility.
- Use mechanical aeration to enhance life processes, water and air absorption, deep ripping, forks, prying tools, worms, radishes and other deep roots as biological pegs, borrowing animals, deep-rooted pioneer plants, mulch holes and nuclei (story of the bush turkey nest).

Soil conditioning with key line system:

Wallace plow deep ripping on contour, or just falling off contour, starting at the key point falling out to the ridge lines.

The principle is the soil becomes the main water storage system and the effects are more air in the soil, moderated temperatures, more soil life, improved p.H, more mineral availability and improved plant and animal health and growth rates.

Difficult soils:

Alkaline soils are expected in deserts, coasts and areas of alkaline rocks.

Acid soils are expected in wetlands, bogs, high rainfall, uplands, siliceous rocks.

Platin soil of island atolls and desert coasts has 0.5 meter deep layer of calcium triphosphate, as hard as concrete. The strategy is to break up the platin layer forming holes, which are filled with humus, mulch and ongoing mulch additions planted with trees. The tree continues to break up the platin, and release phosphates and humic acid released from the decomposing mulch additions breaks down and softens the platin layer further.

Caliche is a tropical equivalent of platin and is found after forest is removed and soil eroded. Feric silicate composition lies 1 to 1.5 meters below the rainforest soil. This situation takes long term recovery using swales mulch pits, and mass planting of pioneer trees to build back topsoil. Best to leave forest as it is.

Non-wetting soils of dry land areas where water rolls off because of an algael-fungal association, which produces a wax. Small areas can be mulched. For larger areas once mulch cover 8% of the surface area recover is possible. On larger areas mix a fine bentonite clay or a commercial gel mixed with the topsoil and seeded to cover crop to prevent erosion. It is also possible core out sand every square meter and drop in a loam or clay loam plug 0.1 meter by 0.3 meter deep.

Clay with drainage problems can be improved with additions of gypsum 2to 3 handfuls every square meter to help seepage down to 2 meters. If possible spread 4 centimeters of sand and mulch on top.

2 – 3 DVDs

EARTHWORKS AND EARTH RESOURCES

Terra-forming is one of our oldest and greatest skills, neither the public at large nor those in architectural or agricultural fields have fully realized the potential of earthworking machines in the modern sense.

Earthworks are necessary and ethical where they:

- Reduce our need for energy.
- Diversify our landscape for food production.
- Permanently rehabilitate damage.
- Save materials.
- Enable better land use, or help re-vegetate the earth.

Earth can be moved for productive reasons, many of them classified as landscape restitution:

- To create shelter; to assist with foundations and to make areas level for floors.
- To terrace hill slopes for stable padi crop, wet terrace, or gardens.
- To raise banks or to dig ditches as defenses against flood, fire, attack or wandering vegetation eaters.
- To drain or fill areas, to direct water flow or runoff.
- To create access roads to those places we commonly visit.
- To get at earth materials, ochres, clays, minerals, and fuels.
- To make holes foe any number of reasons and of greatly varying sizes from fence posts to dams, wells to deeply drilled bores.
- To create special storages and enlarge living space.
- To stop erosive forces carrying off soils.
- To prevent noise pollution.
- To permit recharge of ground waters as swales and ripping.

Earth can be moved with hand held and mechanical diggers, ditchers, augers, drills, blades, buckets, shoes, rakes, ploughs, rippers, delvers, scoops, earthplanes, loaders, rock cutters, draglines, excavators and dredgers. We also move earth with explosives, hydraulic jets, and as an unintentional result of erosive processes generally.

Planning earthworks prior to the actual job is essential for placement, soil tests, surveying and pegging, topsoil storage and re-use planning, and preparing for plant up afterwards.

Planting after earthworks needs serious planning not only for stability, but also to make the most of the opportunity of dominating the bare soil with appropriate plant regimes. We will be in a race with the volunteer weeds seeds to occupy as much space as possible first. As soon as the earthworks have finished we need to over seed with fast growing pioneer ground covers and shrubs and at the same time plant in, bulbs, divisions of clumpers, cuttings, tube pot pioneer trees and larger potted up main trees as the eventual climax layer. On steep

and difficult slopes a net and pan pattern of mini earthworks will help establish pioneers as will logs and branches pegged across the slope to hold mulch.
Dam walls should not be planted with anything that has a tap root, that may penetrate the dam wall, and crack the wall if blown over or pipe the wall through when the tree dies. Bamboo and other clumpers are ideal as are willows and palms.

Slope measurements can be made in many ways, the three most common are degrees 45`, percentages 50% and proportion 1:1.

The average safe slopes used by engineers are:

- Gravels 1:1.5
- Clay well drained 1:2
- Clay wet 1:4

Levels and leveling is performed to ensure spillways work, drains run, gutters flow, buildings sit level and numerous other applications. Leveling equipment can be very sophisticated or extremely simple from a satellite positioning laser level, laser level, theodolite, transit level, hose levels, plane table to simple A-frames. Most of the survey work we need to do is measuring level and very slight grades all of which has been done in the past just using water to check level and the speed of water movement to assess gradient.

Types of earthworks:

- Banks need to be constructed stable for control of water and soil slump. Many methods can be used to prevent slump from cuts above terraces or roads, and need careful planning, vegetation established on banks always assists stability.
- Benching a slope can be used to create roads and house sites. These are quick and easy to cut with a side casting machine, like a bulldozer or a grader on shallower slopes, the lower side becoming a good tree growing position of increased soil depth. Benches can slope <u>slightly</u> off the hill for drainage. In stable soils benches can slope into the hill and infiltrate water to the trees below the bench acting like a swale. Cross wall drains may need to be made every 20 to 30 meters to prevent runoff erosion. These are very useful and functional elements especially in steep country.

Terracing on country that has enough mulch materials, compost supplies and water can be very stable productive systems.

The exception to this is when:

- Terraces built in unstable soils and sediments.
- In areas with hydraulic pressure from water.
- Bunds not constructed stable.
- Large proportion of the landscape is terraced in annual crop with no tree mulch input to crop.
- High rainfall areas terraced and concentrating runoff.

Trees on bunds and between, above and below terraces, should form 40 to 60% of the total landscape, creating a polyculture system creates the best sustainable results.

Terrace construction always starts at the bottom and goes up hill, pulling topsoil down from the next terrace above, finally the surplus stockpiled topsoil of the bottom terrace is transported to the top terrace of the series.

In the tropics terraces should occupy no more than 30% of the catchments landscape and no more than 5% in drylands.

1 – 2 DVDs

AQUACULTURE

Select species (plant and animals) for pond size.

Set up self-forage systems for fish.

Pond sizes:

Mini-ponds in gardens used for predator habitat, water chestnut, water cress, taro, kangkong.

300+ square metre ponds: fish, prawns, cray-fish, eels, bait fish and mollusks . Plants various from edge blue berry to reeds to water chestnut , emergent wild rice , marginal, overhanging mulberry willow.

Self- Forage Systems:

Insectory plants at pond edges attract insects and many fall into the water.
Plant heavily around edges to attract nesting and feeding birds, these deposit manures onto the water, which supply detritus feeders. Ducks and fish are excellent high yielding combinations on ponds.

Trellis crop and overhanging trees important, e.g. silkworm on mulberry trees provide manure, their own bodies, and bits of leaf for fish below.

Provide insect traps over water for fish feeding, e.g. a yellow balloon over water will attract grasshoppers, a baited flytrap will provide hundreds of flies, a black light with a fan will fan insects into the water.

2 DVDs

THE STRATEGIES FOR AN ALTERNATIVE GLOBAL NATION

Invisible structures:

- Necessary legal structures.
- Formal and informal financial strategies.
- Trade
- Self referencing authentication, quality and education.

Permaculture local groups (associations), institutes, academies and universities.

Permaculture political party?

2-3 DVDs

CONTACTS

Course:……………………………………………………………………………………......

Date:…………………………………………………………………………………………...

Teachers:………………………………………………………………………………….