OFFICIAL PERMACULTURE DESIGN CERTIFICATE COURSE

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MODULAR PERMACULTURE DESIGN CERTIFICATE COURSE OUTLINE WITH FOOTNOTES

102706

This curriculum is based on *Bill Mollison's, Permaculture: A Designer's Manual*, **www.tagari.com/?p=58** combined with *David Holmgren's* recent writings on permaculture. **www.holmgren.com.au**.

It provides a more gradual immersion into the basic text which is an encyclopedic reference manual. This 72 hour course follows Bill Mollison's recommended course outline leading to permaculture certification. Permaculture certification gives you the legal right to use the word *permaculture* in your *modus operandi*. Bill Mollison holds the copyright to the word listed in the Oxford dictionary.

You may apply to the *Permaculture Research Institute (Australia)* for a *Permaculture Diploma*, after two years field work based on wide ranging criteria and submission of a permaculture design. The *permaculture diploma* is recognized by a growing number of universities and institutions around the world. **www.permaculture.org.au**

There are now many thousands of students working on many hundreds of projects world wide and as students become teachers, the network grows in preparation for energy descent.

The establishment of permaculture nodes linked throughout communities and bio-regions will help soften the blow and provide learning spaces and a soft place to land for those seeking an ecologically harmonious abundant way of life as conventional systems collapse.

The role of the internet for expanding permaculture is significant. It has created virtual communities of great diversity and resilience which bypass conventional media.

The first two course modules provide broad concepts that become more focused and are applied in the remaining three modules. There are hands-on activities outside of class and visits to local projects.

Students are expected to participate in site specific design projects and present them in the final class for group evaluation.

Design project requirements:
Synopsis.
Problems.

Proposed solutions..
Technique (based on permaculture principals/pathways to sustainability).
Energy audit (cost benefit analysis).
Impact on bio-region.

All Permaculture classes end with a fiesta where we sing, dance and make merry.

MODULE 1.
CONTEXT, EVIDENCE AND DESIGN THEORY.
Paths of Energy Descent.
The Unholy Trinity – Peak oil, climate change, soil depletion.
Paths of energy descent, civic/economic disruption, soft descent.
Discussion and student introductions.
http://www.permaculturedesignsolutions.com/home/index.php
History of Permaculture[1]
Overview.[2]

(From the preface Permaculture: A Designers' Manual. Bill Mollison) Permaculture movement has no central structure, but rather a strong sense of shared work. Everybody is free to act as an individual, to form small groups or to work within another organization. We cooperate with many other groups with diverse beliefs and practices; our systems include good practices from many disciplines and systems, and offers them as an integrated whole.

Great change is happening. These are not as a result of any one group or teaching, but as a result of millions of people defining one or more ways in which they can conserve energy, aid local self-reliance, or provide for themselves. We acknowledge our own work as modest; it is the totality of such modest work that is impressive. There is so much to do and there will never be enough people to do it. But we all must try to increased our skills, to model trials, and to pass on the results.

2 The United Nations Environment Program (UNEP) has shown that populations with significantly damaged local ecosystems are seven times more vulnerable to natural disasters. How are we to live, and redesign systems to harmonize with underlying natural patterns?

Destructive post-war industrial agriculture has poisoned our land and water and reduced biodiversity. It has removed two-thirds of the world's top soil from previously fertile landscapes. A design approach called permaculture has evolved from this disaster and was first made public with the publication of Permaculture One in 1978.

Permaculture seeks to design sustainable human settlements whilst preserving and extending natural systems. It seeks to develop and maintain a cultivated ecology in all climate zones and includes principles of design, understanding natural patterns in nature, climate factors, aquaculture, social, legal and economic aspects of human settlement.

The word permaculture was coined by Australians, Bill Mollison and David Holmgren in the mid-1970's. It describes an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man. It is a conflation of permanent culture and since we need permanent agriculture to survive the idea embodies both.

Ecology – passive observation of systems – protesting ineffective! We know what we don't want. What do we want?

Permaculture One was really a proposal – 1988 designer's manual released.
Bill wins Right Livelihood Award and award from Russian Academy of Science and permaculture design science was recognized as such.

…it is a solution based idea.

Care of Earth – living and non-living
Care of people
Return of surplus to One and Two.

Permaculture grows like weeds to in damaged environments.

SUSTAINABILITY
…produces more energy than it consumes over its lifetime

Ethics of permaculture:

1} Shared ethics of "earth care", "people care" and "fair shares" (which is shorthand for limits to population and consumption and fair distribution of resources to further the work of earth-care and people-care). Permaculture stresses the importance of personal responsibility for one's actions.

2} Ecological principles derived by observation of natural systems.

3} Design tools and processes that allow an individual or group to assemble conceptual, material, strategic components in a pattern or plan of action that can be implemented and maintained with minimal resources.

After the publication of Permaculture One2, Mollison and Holmgren further refined and developed their ideas with both originators designing hundreds of permaculture projects. Mollison has lectured in more than eighty countries.
What Permaculture is:

The philosophy of permaculture is one of working with nature to apply sustainable systems to preserve and where possible, extend the effectiveness of natural systems in a harmonious integration of fundamental needs (elements) such as landscape, sun, shade, water, stone, heating and people.

The rise of permaculture parallels the rise in environmentalism going back to Rachel Carson in the late 1950's[3]. In the 1960's, Bill Mollison saw the destruction of his environment in his beloved

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Low impact energy systems like solar energy, small scale hydro power, domestic organic food supply, greenhouses, use of recycled building materials, eco-friendly home design, better utilizing our diminishing non-renewable recourses.

Permaculture One was far more successful than anticipated. It seemed to meet the need of the emerging environmental counterculture looking for something positive and sustainable to align with. It was published in five languages but is now out of print. But it has been superseded and refined in later works.

While Bill Mollison traveled the world teaching and promoting permaculture, David Holmgren was more circumspect about permaculture's potential to live up to its promise. He concentrated his efforts on testing and refining the idea, first on his mother's property in southern New South Wales (Permaculture in the Bush, 1985;1993), then at his own property in central Victoria which he developed with his partner Su Dennett (Melliodora, Hepburn Permaculture Gardens - Ten years of Sustainable Living, 1996a; Payne, 2003).

VISIBLE STRUCTURES
Water systems
Organic systems
Infrastructure
Structures
Landscape

INVISIBLE STRUCTURES
Legal
Finance
Trust
Ethics

It is application of common sense.

3 Disturbed by the profligate use of synthetic chemical pesticides after World War II, Carson reluctantly changed her focus in order to warn the public about the long term effects of misusing pesticides. In *Silent Spring* (1962) she challenged the practices of agricultural scientists and the government, and called for a change in the way humankind viewed the natural world. http://www.rachelcarson.org/

Another original Marxist critic who connected nature with society is Murray Bookchin. http://www.social-ecology.org/staticpages/index.php?page=mb_trib

Tasmania. After attending demonstrations and protests, he reflected for some years and emerged with the idea of "permaculture", a more positive approach to social change focused on creating permanency in agriculture and sustainable culture. "Permaculture" is the contraction of this idea.

Concepts and themes of design.[4]p. 10

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4 CONCEPTS AND THEMES OF DESIGN.

Prime Directive of Permaculture: The only ethical decision is to take responsibility for our own existence and that of our children. (To the seventh generation)

Principles of Cooperation: Cooperation not competition is the very basis of future survival.

The Ethical Basis of Permaculture:

Care of Earth: Provision for all life systems to continue and increase.

Care of People. Provision for all people to access those resources necessary to their existence.

Setting limits to population and consumption: By governing out own needs we can set resources aside returning resources to both to further the above principles

Rules of Natural Resources:

1.Reduce waster hence pollution.

2.Replace lost minerals

3. Do energy audit

4. Biosocial impact assessment to gauge long-term effects on society and act as a buffer or eliminate negative impacts.

Live Intervention Principle: In chaos lies unparalleled opportunity for imposing creative order.

Law of Return: Whatever we take we must return. Nature demands a return for every gift received to the user must pay.

Directive of Return: Every object must responsibly provide for its own replacement. Society must, as a condition of use, replace an equal or greater resource than that used.

Set of Ethics on Natural Systems:

Implacable and uncompromising opposition to further disturbance of any remaining natural forests.

Vigorous rehabilitation of degraded and damaged natural systems to a stable state.

Establishment of plant systems for our own use on the least amount of land we can use for our existence

Establishment of plant and animal refuges for rare and threatened species.

The Basic Law of Thermodynamics: All energy entering an organism, population or eco-system can be accounted for as energy either stored or depleted. Energy can be transferred from one form to another but it cannot be created or destroyed. It is a constant. No energy conversion system is every completely efficient. The total amount of energy in the universe is constant and total entropy is increasing.

Birch's Six Principles of Natural Systems:

Nothing in nature grows forever. There is a constant cycle of decay and rebirth.

2. Continuation of life depends on maintenance of the global bio-geochemical cycles of essential elements in particular; carbon, oxygen, nitrogen, sulphur and phosphorous.

The probability of extinction of populations or species is greater when the density is very high or low. Both crowding and too few individuals of a species may reach thresholds of extinction.

The chance that a species has to survive and reproduce is dependent primarily upon one or two key factors in the complex web of relations of the organism in the environment.

Our ability to change the face of the earth increases at a faster rate than our ability to foresee the consequences of change.

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

Practical Design Considerations:

The systems we construct should last as long as possible and take least maintenance.

These systems, fueled by the sun, should produce more than their own energy needs to supply needs of the people who create and control them. Thus they are sustainable as they sustain both themselves and those who construct them.

We can use energy to construct these systems providing that in their lifetime, the store or conserve more energy than we use to construct them and maintain them.

Mollisionian Permaculture Principles:

Work with nature rather than against the natural elements, forces and pressures, processes, agencies and evolutions so that we assist rather than impede natural developments.

The problem is the solution; everything works both ways. It is only how we see things that makes them advantageous or not (if the wind blows cold, let the us use its strength and coolness to advantage). A corollary of this principle is that everything is a positive resource; it is jus up to us to work out how we may use it as such.

Make the least change for the greatest possible effect.

The yield of a system is theoretically unlimited. The only limit on the number of uses of a resource possible within a system is in the limit of the information and the imagination of the designer.

Everything has an effect on its environment

A Policy of Responsibility to relinquish power.

The role of the beneficial authority is to return function and responsibility to life and to people; if successful, no further authority is needed. The role of a successful design is to create a self-managed system.

Categories of Recourses

1 Those which increase my modest use

2. Those unaffected by use.

3.Those which disappear or degrade if not used.

Those reduced by time.

Those which pollute or destroy other resources if used.

Policy of Resource Management: A responsible human society bans the use of resources which permanently reduce yields of sustainability resources. e.g. pollutants, persistent poisons, radioactives, large areas of concrete and highways, sewers from city to sea.

Principles of Disorder: Any system or organism can accept only that quantity of a resource which can be used productively. Any resource input beyond that point throws the system or organism into disorder; oversupply of a resource is a form of chronic pollution.

Definition of Systems Yield: System yield is the sum total of surplus energy produced by, stored, conserved, reused, or converted by the design. Energy is in surplus once the system itself has available all its needs for growth, reproduction and maintenance.

The Role of Life in Yield: Living things including people are the only effective intervening systems to capture resource on this planet and to produce a yield. Thus, it is the sum and capacity of life forms which decide total system yield and surplus.

Limits to Yield: Yield is not a fixed sum in any design system. It is the measure of the comprehension, understanding and ability of the designers and managers that design.

YIELD
A function of design/energy back related to energy used.
Energy conserved and stored and generated within system.
Sum of storage
Complexity and diversity
Useful storage

Dispersal of Food Yield over Time:
1 By selection of early, mid and late season varieties.
2 By planting the same variety in early or late ripening situation.
3. By selection of long-yielding varieties
4. By a general increase in diversity in the systems so that:
Leaf, fruit, seed and root are all productive varieties.
By using self-storing species such as tubers, hard seeds, fuel woods, rhizomes which can be cropped on demand.
5.By techniques such as preserving, drying, pitting and cool storage.
By regional trade between communities or by utilization of land at different altitudes and latitudes.

Principles of Cycles in Nature: Every cyclic event increases the opportunity for yield. To increase cycling is to increase yield.
Cycles in nature are diversion routes away from entropy. Life itself cycles nutrients giving opportunities for species to occupy time niches. .

Permaculture is a design system based on ethics and natural patterns in nature. We introduce the ethical basis for permaculture and the fundamental principles and directives including the basic law of thermodynamics, yield, surplus and abundance.

Prime Directives of Permaculture.
Principles of Cooperation.
The Ethical Basis of Permaculture.
Rules of Natural Resources.
Live Intervention Principle/Chaos theory.
Law of Return.
Directive of Return.
Set of Ethics on Natural Systems.
The Basic Law of Thermodynamics.[5]

Types of Niches :

Niche in space or territory (nest or forage site).

Niche in time (cycles of opportunity

Niche in space time (schedules)

Principle of Disorder: Order and harmony produce energy for other uses. Disorder consumes energy to no useful end.

Principle of Stress and Harmony: Stress may be defined as either prevention of natural function or of forced function and conversely, harmony as the permission of chosen and natural functions and the supply of essential needs.

Principles of Stability: It is not the number of diverse things in a design that leads to stability, it is the number of beneficial connections between these components.

Information as Resource: Information is the critical potential resource. It becomes a resource only when obtained and acted upon.

5 ENERGY AND STORAGE

Slow escape of energy – as many links as possible in interconnecting systems.

Sun to Sink – slowing the path of energy to inevitable entropy.

Storage and control, rate, conservation.

Web of life - redundancy – a spider's web with 80 percent of its web broken will still catch food for the spider.

Storage of energy

Water sources – supply, distribution, paths to evaporation.

Sunshine

Water wheel is almost 100% effective transfer of energy.

COMPRESSED AIR AND TROMPES

Isothermic compressed air

50 ft. deep equal to 140 psi

Birch's Six Principles of Natural Systems.
Practical Design Considerations.
Mollisionian Permaculture Principles.
Yields and cycles.[6]
Niches.
Principles of disorder, stress, harmony and stability.
Information as a resource.

MODULE 2.
PATTERN UNDERSTANDING, DESIGN APPLICATIONS, TREES AND ENERGY. P.35
Pattern Understanding.[7] (Ch. 4). P.70
There are patterns in the landscape, there is meaning in the stars, nature's repeating patterns

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1935 Oil companies buy TROMPE technology – air compressed cars.
Will run pneumatics, freezer, mining, car

Compressed air does not lose power and will convert to electricity
Isothermic compression will clean water.

Used in Europe for trams, refrigeration, cafes, extremely efficient.

6 INCREASE YIELD
Modify landform.
Water storage.
Soil reconditioning.
Windbreaks, forage forests.
Selective farm reforestation.
Market process and strategies.
Social/financial – CSA agriculture.
Crop techniques.
Extending yields.

Principal of Enough:
Oversupply of resource is a form of chronic pollution.
System can use only the quantity of resources that can be used. The remainder is pollution or waste.
Permaculture seeks to turn waste (wasted energy) into profit or put another way, slow the path of energy to its natural entropic state.

This is a process of time (schedule), technique (hands-on) and design. Design is multi dimensional rather than linear.
7 Pattern understanding. The curve described by the earth as it turns is a spiral, and the pattern of its moving about the sun…the solar system itself being part of a spiral galaxy also describes a spiral in its movement…Even for the case of circular movement, when adds the passage of time, the total path is a spiral…The myriad things are constantly moving in a spiral pattern…and we live within that spiral movement…p.70 ibid

teach us how to live. An investigation of patterns from mythology, tribal cultures, nature and the human body.

Methods of Design[8] **(Ch. 3).**p.35
Design and scale overview.
Edge thinking.
Orders of magnitude.
Tribal use of patterning.[9]

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8 METHODS OF DESIGN

Definition of Permaculture Design: A system of assembling conceptual, material and strategy components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth.

Prime directive for function: Every component of a design should function in many ways. Every essential function should be supported by many components.
Design is a continuous process and is evolutionary.

Components of Design:
Technique – one-dimensional, how we do something. Not about design.
Strategies – Adding time to technique – planting schedules and forward planning.
Materials – wood, stone, glass, mud etc.
Assembly – putting it together

Principal of Self-regulation: The purpose of a functional and self-regulating design is to place elements or components in such a way that each serves the needs and accepts the products of other elements.

9 An Aborigine Creation Story: When the earth was new-born, it was plain and without any features or life. Waking time and sleeping time were the same. There were only hollows on the surface of the Earth which, one day, would become waterholes. Around the waterholes were the ingredients of life.

Underneath the crust of the earth were the stars and the sky, the sun and the moon, as well as all the forms of life, all sleeping. The tiniest details of life were present yet dormant: the head feathers of a cockatoo, the thump of a kangaroo's tail, the gleam of an insect's wing.

A time came when time itself split apart, and sleeping time separated from waking time. This moment was called the Dreamtime. At this moment everything started to burst into life.

The sun rose through the surface of the Earth and shone warm rays onto the hollows which became waterholes. Under each waterhole lay an Ancestor, an ancient man or woman who had been asleep through the ages. The sun filled the bodies of each Ancestor with light and life, and the Ancestors began to give birth to children. Their children were all the living things of the world, from the tiniest grub wriggling on a eucalyptus leaf to the broadest-winged eagle soaring in the blue sky.

Approaching permaculture design, components and assembly, organizing principles for landscape, homestead and bioregion. Applying harmonious design, soft energy systems, basic water management.

Developing design:[10]

Rising from the waterholes, the Ancestors stood up with mud falling from their bodies. As the mud slipped away, the sun opened their eyelids and they saw the creatures they had made from their own bodies. Each Ancestor gazed at his creation in pride and wonderment. Each Ancestor sang out with joy: "I am!". One Ancestor sang "I am kangaroo!" Another sang "I am Cockatoo!" The next sang "I am Honey-Ant!" and the next sang "I am Lizard!"

As they sang, naming their own creations, they began to walk. Their footsteps and their music became one, calling all living things into being and weaving them into life with song. The ancestors sang their way all around the world. They sang the rivers to the valleys and the sand into dunes, the trees into leaf and the mountains to rise above the plain. As they walked they left a trail of music.

Then they were exhausted. They had shown all living things how to live, and they returned into the Earth itself to sleep. And, in honor of their Ancestors, the Aborigines still go Walkabout, retracing the steps and singing the songs that tell the story of life.

10 DESIGN
Access
Water
Structures

<u>Patterning the landscape:</u>
Function and assembly of species and materials, water and access, climate, bio regional survey.

<u>Techniques and Strategies:</u>
Technique – How, one dimensional.
Strategy – How and When, two dimensional.
Design – Patterning and multi-dimensional.

Maps: Analysis of elements, sector planning, observation, experimentation, lists and Links to supply needs, failure in design equals “work”. Every element should provide many functions. A tree may supply up to 500 life connections in web of life. Each element should have at least three uses/multiple use

WEB OF LIFE
Sun/Source
Sink/Entropy
How long can we keep energy here – connections between elements build stability.
Return energy to the system before it sinks. Swales.
Entropy is about life. – Life is anti-entropy.

Zone and Sector Analysis.[11]
Guilds in Nature and Design.
Succession: Evolution of systems.
Procedures in Property Design.
Creating harmonious systems.
Integrating functionality.
Relationships in design.
Reading the landscape: applying harmonious design.[12]

As water flows it looses energy – raindrop becomes river carrying life, gaining life as it flows to edge of sea – building life but losing energy. At delta, mangrove is rich in life but low in energy. Silt capture, reed beds and ponds. Animal manure at top of system to flow through sink to reed beds – cut reeds, collect silt and soil as energy to reuse. When one strand breaks the system will still work. Up to 80% may break but web of life will still work like a spider web does. Industrial systems fragile.

11 SECTORS
Weather and wind – prevailing/ wind breaks and building placement
Direction of Equator and sun angles. Wild life corridors
Equinox South Sept. 23, North March 23. Vertical sun crosses the equator.
Solstice June 22, June 22 – get sun angle
Design with the sun at the top of the map.
Easterly slope is always more gentle than westerly because of afternoon sun.
Where is water? Where is heat? Access and structures – mapping.
Hold water as long as possible – swales, dams etc. Access - major and minor – harmonically placed. Select elements and place in pattern relationship. Animals. Plants. Structures – make lists and connect them to find links.
Design by observation – the indigenous, over the seasons.

12 In TEMPERATE ZONES 40% biomass above ground, 60% below. A fresh start every year. Introduce nitrogen fixing plants – nitrogen moves through herbage then trees. Soil is bacterial based.

TROPICS 90% of biomass above ground 90%, 10% below. There is no winter – no slow time within 10 degrees of the equator and hardly any soil (25ml).

90% of biomass held in suspension in trees – animals live in trees. Hardly any herbage, grasses lot lots of palms and legume trees, deciduous drop leaves to protect soil from coming rain. It has fungi based soil produced by fallen trees. When trees removed from tropical landscape there is no bacteria to build soil. Tree actually want to return to the landscape so we cut back and burn to produce grassland.

In Tropical climate, aquaculture is way to go – 30/50 times more protein produced per acre than with live stock. FAO admits there has never been successful agriculture system applied to topics. Many nutrients are in the water.

PAIN and PLEASURE anchor knowledge.
Walk the land without prejudice.
Soil is naturally acid except near the sea sometimes.

Swales and land harmonics.
Habitat, flood and fire mitigation, food, shelter and transportation.
Energy conservation/auditing, sustainability.
Capitalizing on the Sun/Solar energy, passive and PV.
Analysis – site characteristics, observation, deductions from nature, options and decisions, methods of design: data overlay, map overlay, random assembly, flow charts.

Trees and their Energy Transactions. [13] **(Ch. 6).** p. 137

CONSTANTS:

Full moon comes up exactly as sun goes down and the rises 53 minutes later every day.

If you pump a desert you salt the landscape. 19 year cycle of the moon across the equator from north to south and back

SOIL EROSION is bigger problem by far than pollution.

EDGE THINKING (Lawton)

Lawn does not exist in nature – Taj Mahal had first recorded lawn observed by nights of the Crusade.

13 TREES AND THEIR ENERGY TRANSACTIONS

Tree is an energy transducer of wind, sun and rain. If too much sun, plant will over saturate. At latitude 60 degrees, low sun and cloudy so plants grow in longer daylight. Forty-percent of tree is below ground with root system about 30 cm deep. Between trees there is communication at root level and through air – active signaling., A tomato plant will release smell if you touch it.

Phloem is root matter.

The rain tree collect water and drip line is sufficient to provide small village with its water. A blue gum tree exhales 1 to 5,000 gallons of water in a day. Rain clouds form 15% off direction of wind.

Water filtered through plants is almost perfect for watering other plants. Phosphates produced and minerals from soil and rain are washing back into soil. Sublimation – from solid to gas/snow to water.

FORESTS. Forests for fuel, forage, structures, shelter, animal barrier, food, energy conservation (60% of energy conservation can be achieved outside the house.

Seaward facing slopes gather rain nutrients.

FOREST TYPES:

Fuel/coppice

Pole timbers/bamboo

Forage – depends on animals – chicken and cow not fussy, horse is

Structural sawn species - pioneer species.

LIGHT AND TREES

Some absorb and others reflect creating warmer soil and different insect life. Birches reflect of white trunk. Pond will reflect and if reflecting Birches will double reflection. Dense, dark trees will warm air. Albado effect – reflected light. Hot tree – red leaves.

Trees are the backbone of our eco system. Without trees we are gone. Trees help build soil and hold moisture, mitigate erosion and flooding and can provide enormous quantities of food. Timber will become a very valuable resource in energy descent.
Forest farming for food security.
Food forest gardens.[14]
Reforestation.
Trees in flood mitigation

MODULE 3.
WATER, SOIL, EARTHWORKS.
(Ch. 5). Climate Factors. The Hydrological Cycle.[15] p.106

Most light frequencies stripped out after reflection and absorption leaving RED which is good for growing mushrooms.

14 COPPICE AND POLLARD
When we cut the tree it naturally puts out additional root systems and in tropics will increase nitrogen and herbaceous, leguminous mulch. Cut at end of wet season

Plant fruit trees with 90% support species and 10% productive at the start. At climax reverse this and one acre will feel like five. Climbers/root-yeild/ground-cover/clumpers/herbs/shrubs/understorey/climax. Brazil nut tree – one nut has about 13 seeds and will feed a man for a day.

ORCHARDS
Install water collection/swales, pioneer ground cover, more permanent perennial groundcover, pioneer tree plantings, diversification of fruit trees, heavy mulching – no grass.

15 FRESHWATER FISH: The Miner's Canary in the Aquatic Realm.
An interview with Melanie Stiassny, Associate Curator, Department of Ichthyology, American Museum of Natural History, 1995. Andrew Leslie Phillips for Australian Broadcasting Corporation..

"I'm an evolutionary biologist. I have a particular interest in fish. I'm also very interested in conservation biology simply because of the way things are going. When you start working with animals in the field you very quickly realize that you have to save the field first so there will be animals to study."

Dr. Stiassy's research focuses on the systemics of fresh water fish and fauna in Madagascar and Africa. Her interests include conservation biology of freshwater fish and she is a member of the museum's current bio-diversity initiative in Tanzania.

I found Dr. Melanie Stiassny in her office in the cavernous corridors inside New York's Museum of Natural History. It is a large spacious room and yellow sunlight streams in through the large ornate windows across her large untidy desk. Huge stuffed fish hang from the walls with charts and anatomical drawings. There's a Walkman on her desk and a pair of yellow roller blades tossed in one corner – she blade around Central Park at lunchtime.

“My specialty is fish so I’m an ictholologist and I have really grown to love fish tremendously. They are a fabulous model to examine evolutionary principles. They are an incredibly important indicator organism that tells you the health of aquatic systems. In my case I work primarily with freshwater fish which are like the miner’s canary in the aquatic realm.

“You can learn about the health of fresh water by understanding what’s happening to fish that live in fresh water.”

Dr. Stiassny pulls her slick blond hair back and turns to a nearby fish tank bubbling on her work table. I was there to interview her after attending a conference on theories of evolutionary extinction. Where people settled, the animals disappeared in a dreadful syncopation. Some at the conference postulated humans were a kind of pathogen.

“Take this aquarium here – its housing two very interesting residents that have become pets to me – they are very rare species called Parotalatier Polanai – cyclic fish, from Madagascar.”

She goes on field trips to Madagascar, an enormous island in the Indian Ocean off the coast of Mozambique on the east-central African coast. It’s the fourth largest island in the world.

“Historically Madagascar has been isolated in the Indian Ocean for about 60 million years. It broke off Africa at about the same time India did - about 180 million years ago. It drifted into its present position about 120 million years ago.

India broke off between 80 and 60 million years and opened up the Indian ocean and pushed up the Himalayas so the end result of this story is that Madagascar is this enormous island that has been in isolation for all these millions of years - so have all the organisms that you find on that island – both the plants and the animals.

“Madagascar has been likened to a naturalist wonderland – it’s a place where evolution has just gone on its own and it’s a place that provides very special insights into the evolutionary process. Its also a place that in recent times – when I say recent I mean the last 2,000 years, which is when we think people first came to Madagascar - since then we’ve seen the most incredible perturbations and degradations of its land and forests – rain forests and dry forests. Its undergone the most extreme environmental pressure as people have cleared the land basically to graze cattle, clear land for growing rice so cattle and rice are really what people of the island are most interested in eating.

You cannot fill the Aral Sea with tears.

An Uzbek poet wrote “you cannot fill the Aral Sea with tears” when he realized the Aral sea was disappearing. It’s a massive body of water, the fourth largest inland sea or lake in the world, located in the former Soviet Union in Uzbekistan – north of Afghanistan, east of Iran in the bottom southern region of what used to be the Soviet Union.

“The Aral Sea is a landlocked endorheic sea. Since the 1960s the Aral Sea has been shrinking, as the rivers that feed it were diverted by the Soviet Union for irrigation. The Aral Sea is heavily polluted, largely as the result of weapons testing, industrial projects, and fertilizer runoff before and after the breakup of the Soviet Union.”

How blue is our planet?

“We are familiar with those satellite images of earth and we see ‘the blue planet” but it should be called ‘the water” planet’. Three-quarters of the planet is covered with water but 97.5 percent is marine – salt water. Just 2.5 percent of the planet’s water is actually fresh water.

“If you took a bottle of coke to represent the earth’s water probably three of four capfuls may represents the amount of fresh water on the planet. But it much more dire than that because most of that fresh water isn’t available for humans, animals, agriculture and industry.

“Sixty-nine percent of fresh water is locked in the solar poles - until recently. Of course now the poles are melting into the sea so we are losing fresh water this way.

“Thirty percent of fresh water is stored underground in deep water aquifers and less than one percent is soil moisture as permafrost and ground ice. This leaves a tiny percentage available on the planet for things to live in, for us to drink and use – that’s all the rivers and lakes on the planet. We’re talking about less than one-hundredth of a percent (.001%) of the planet’s water is actually available for things to live in and for us to use.”

The hydrological cycle.

“But I want to make a quick point about that because what we really have to bear in mind when we start talking about how we are going to sustain that tiny amount of water – really what we need to be talking about is the rate at which fresh water is replenished on the planet through the hydrological cycle coming down as rain and snow and being recycled – that’s the water we dip into to use.”

“The water cycle — technically known as the hydrologic cycle — is the continuous circulation of water within the Earth's hydrosphere, and is driven by solar radiation. This includes the atmosphere, land, surface water and groundwater. As water moves through the cycle, it changes state between liquid, solid, and gas phases. Water moves from compartment to compartment, such as from river to ocean, by the physical processes of evaporation, precipitation, infiltration, runoff, and subsurface flow. Movement of water within the water cycle is the subject of the field of hydrology.

“Some people have said that if the world’s water could fit in a bath tub, the portion that could be used sustainably in any given year is less than one-teaspoon. That teaspoon of water is all we’ve got to support human populations, agriculture and industry plus all the water needed to sustain the natural ecosystems.

“That teaspoon of available fresh water is the same size today as it was 2,000 years ago when the planet’s population was about three-percent of the current size. So we are still dipping into the same teaspoon and we will continue dipping into the future.

„Since 1940 the world population has doubled and water consumption has quadrupled. We need to irrigate more and more land to produce enough food to support the rising population and frankly, we are very quickly reaching the upper limits of sustainability – water is fast becoming a limiting factor."

The main drain on water is in agricultural systems, irrigation and industry. Domestic usage is really a very small component.

"One of the indices used to look at the so called development of a nation or a region is to look at how much of water usage is industrial and how much agricultural – generally about two-thirds of all water is for agriculture, mainly irrigation. About twenty-three percent is for industry, leaving eight percent for domestic use and of course these numbers vary tremendously in different regions.

„So the state of water is precarious. I large proportion of our fresh water is underground in aquifers and some are very deep and actually contain fossil water that's been there for a very long time – perhaps thousands of years of storage. Pulling this water out of the ground is unsustainable. We are killing the goose that laid the golden egg – it's a very short-term perspective – we've begun to plunder subterranean water reserves.„

Concentration of species in fresh water.

"I am a specialist in fish so I t end to look at things from a fish's perspective. Of the 22,000 species of fishes alive on the planet today, about half are found in fresh water. That means nearly half of all living species of fish actually live in less than one-hundredth of a percent (.001%) of the earth's water. That's a tremendous concentration of biodiversity.

„Put another way – fish comprise nearly half of all vertebrates alive on the planet today – animals with backbones. When you add them all together you have about half on land and half in water. Half of all living vertebrates are fish. Therefore I can rephrase that statistic about concentrations of species in water.

„We have about 44,000 known species of vertebrates on the planet including fish. So about one-quarter of all vertebrate bio-diversity is concentrated into less than one-hundredth of one percent (.001%) of earth's water. And its not just fish, its all the other organism essential to life in water too.

„We think of the sea as being so tremendously rich and in many respects it is. But in terms of actual living numbers of plants and animals its been estimated that on a percentage basis, fresh water is probably about sixty times richer. So we are talking about a fantastically rich biological medium and ecosystem in fresh water systems.

„The other aspect of fresh water that I think make it so vulnerable is simply you can look at these fresh waters of the world – these lakes and rivers, just like islands – I mean they make a perfect analogy – instead of being islands of land surrounded by water, these are islands of water surrounded by land and just like all of the animals that live on islands – their vulnerable because if something happens there is no escape – its exactly the same in fresh water. We are talking about extremely vulnerable habitats and that's exactly what we see in our environment as we cut down forests, alter water flow patterns in rivers and lakes, we build dams, we divert for irrigation – all of those

changes have a tremendous cascading effect on the animals living in those water systems. Bottom line is that there is no way out – there is sea at one end and land at the other."

Wetlands

"What we have done to wetlands throughout the globe is quiet tragic. Over a period of about 200 years, the lower 48 states have lost more than half of their original wetlands mainly through drainage to provide land for agriculture. That's like losing 60 acres of wetlands for every hour that passed since the U.S. was established.

"There is a tendency to look at swamps and marshes as prime candidates to be drained and turned into pasture but wetlands are far more valuable than pasture.

"It is estimated that 60 percent of the world's total stream flow is regulated. And here is one last sorry statistic: there was a nationwide river inventory in the U.S. which estimated that of more than five million kilometers of streams and rivers in the nation, most have been so radically altered that just two-percent are of sufficiently high quality to be worthy of federal protection.

"Its one of those things – you don't realize what you've got until its gone. I think now we are beginning to reach a point where what we've lost is really becoming understood and we have a cascading effect through our ecology.

"We need new ways of thinking about water and about natural resources generally. It is amazing that governments spend vast amounts of money to support environmentally destructive behavior like draining wetlands.

"Much of the water overuse is in industry and agriculture. Water is actually subsidized for industry and agriculture. Irrigation systems are inefficient (37% efficient) and are often built and managed by public agencies at minimal charge.

"The return on these irrigation programs probably average no more than about ten to twenty percent of the true cost of delivering water.
We need to rethink this false economy."

How important was the Green Revolution?

"The Green Revolution was tremendously important. To feed our expanding population we've had to employ tremendous increase in irrigation – land was reclaimed from desert to be irrigated and farmed. Water provided the crops to feed the growing population. And genetic modification of existing crops produced very high yields but very thirsty crops creating even more demand for water.

"Agriculture is the biggest drain on water consumption – it uses more than two-thirds of our supply and it is very inefficient so if we can improve efficiency we can save enormous amounts.

"If governments stopped subsidizing and under pricing water it would help a lot. Water costs less in Arizona than it does in Wisconsin. This is a false economy. We need to recycle more water. It's insane to be tapping into aquifers of pure high quality fossil water and squiring it on the land that will be salinated. We need to redesign agriculture.

We live in a time of climate change. To understand how to adapt and mitigate the impact of climate change we need to understand how climate works and its impact on landscape and settlement patterns.
Weather systems, the hydrological cycle, precipitation,
Radiation, color, heat transfer, hot cold and dry climates
Characteristic and landscape effects.[16]
Wind. [17]

“They grew cotton around the Aral Sea, a semi-arid region and cotton is one of the thirstiest crops – sugar is the thirstiest. We should not be growing these crops in arid regions. I think we are going to be forced to really start looking at how we are using water and why we are using it in the way we are – why we are subsidizing certain practices in the way we are.

How much is water worth?
“Water is worth everything. You can’t have anything without water. Water is central to life.
end.

16 ARID “like a sheet of glass – if you break the system it is very difficult to repair. – The bones of the country with the flesh washed off. You are working with climate, landform and culture. Note: Most garden books are written for temp. zones. TEMPERATE: soils are bacterial. TROPIC soils are fungal based, grown from fallen trees. When we remove trees there is no bacteria to build soil. When forest is cut it naturally tries to regenerate and we cut back again creating unnatural grassland which does not produce soil. TROPICS/AQUACULTURE – is 30/50 times more productive per acre than livestock.

JORDAN – DEAD SEA VALLEY

http://www.permaculture.org.au/

150mm/6” rain pa – 75mm in four hours.
“In two days, 10 years of water passed.” How do you trap it?

Weeds and pioneer plants are not the enemy.

17 WIND
60% of wind will flow over top of forest and 40% will enter. 100 meters in wind has reduced, 1,000 meters in it has disappeared. Friction causes heating in forest. Wind drops sediments combed from the air, in piles along forest edge where animals find food and refuge and deliver manure.

Tree at the forest edge will be taller and stronger. There is more moisture and rain run-off at the edge and the wind collects stuff like bacteria from the leaves and branches.
Syrangi (sp) is precursor to rain and is abundant in tea plantations so we get thunder storms downwind of tea plantations. Syrani collects ice and science removed it to stop frost on strawberries and created drought. The forest encourages the rain. Inside the forest it will be a degree warmer, moist warm air rises from the forest from transpiration as steam.

Water (Ch. 7). p.152

Water is the driving force of nature.[18] *The amount of fresh water on the planet is finite. Half of the*

18 WATER: Evaporation from oceans – 1 molecule per cubic meter is salt in wind.
Rain water from sea full of minerals and nutrients, phosphates, organic matter washed off trees. Requires about 11mm of rainfall before rain saturates through tree to earth. The forest is a great moderator in all climates.
Transpiration - H2O in and H2O18 out – 40% of rain inland. Inland, trees take over function of the sea. Trees and rain are in an intimate relationship.

The rain tree collect water and drip line is sufficient to provide small village with its water. A blue gum tree exhales 1 to 5,000 gallons of water in a day. Rain clouds form
15% off direction of wind. Water filtered through plants is almost perfect for watering other plants. Phosphates produced and minerals from soil and rain are washing back into soil.
Sublimation – from solid to gas/snow to water.

Forests for fuel, forage, structures, shelter, animal barrier, food, energy conservation (60% of energy conservation can be achieved outside the house.

Seaward facing slopes gather rain nutrients.

FOREST TYPES
Fuel/coppice - When you coppice legumes tree the root dies off in proportion to cut above ground and that will enrich the soil with nitrogen and carbon underground, aided by insect process.
Pole timbers/bamboo
Forage – depends on animals – chicken and cow not fussy, horse is
Structural sawn species - pioneer species. Redwood can lift water 400 feet in hydraulic process.
Compost corridors in soil through root systems in dendretic pattern.
Tree is a pump.
Space stacking
Time stacking.
Coppice when extra light may be required.
Legumes often have flowery yellow flowers with nitrogen rich seeds.
Flowing and pruning can adjust nitrogen fixing – “time stacking”.
Plant four times more densely than recommended.

LEGUMES/TIME STACKING
Brush – 1 year
Shrubs – 3-7 years
Small trees – 5-15 years
Trees – 20 years
Long term –

Duty of Water

world's fish live in fresh water. Wars will be fought over water. Water is life.

Overview of water. Orographic and Forest effects. Water harvesting, swales, ponds, dams and earthworks. Recycling and waste management. Compost toilets, humanure, reed beds and aquaculture.[19]

To create life, aquaculture. energy systems. The idea is to use water as many times as possible – increase surface storage, reduce run-off, decrease evaporation

"Water for Every Farm" P.A. Yeoman

www.sare.org/sanet-mg/archives/html-home/25-html/0497.html

WATER COLLECTION TANKS

Poly, concrete/lime, zinc/Au – guaranteed 25 years, aquaplate

Biocides – estrogen analog in biocides, growth hormone forces plants to grow themselves to early death and much of it pollutes the water table.

19 The sales of organic foods grew from $4.7 billion in 1997 to $9.2 billion in 2004. The increase continues annually at the rate of 20 to 25 percent. Paralleling the growth of organic food sales has been seafood consumption; a growth attributed primarily to associated health benefits of eating fish. Concurrent with this trend has been the decline of all major seafood species due to over-fishing. The rise of aquaculture has been given as a solution that not only provides healthy products, but also offers crops that can be grown sustainably and support many struggling farming communities. However, due to excessive use of medications, the negative environmental record of aquaculture, and the exploitation of overseas communities to provide inexpensive products, the promises of aquaculture have not been fully realized.

Aquaculture production has grown rapidly in the vacuum left by falling fishery supply. In just one decade, worldwide aquaculture production grew over 266 percent: from 30 billion pounds in 1991 to 80 billion in 2001.

The good news about this boost in production is that it may alleviate the pressure on world fisheries; the bad news is that the aquaculture industry is repeating many of the same environmental mistakes made by beef, hog, and chicken producers. Seventy percent of the pollution to the U.S. water table is caused by agricultural runoff, the majority of which is from animal manure. The environmental impact of aquaculture has the potential to be as significant. The warning signs are evident in many places. In the early 1980's the Norwegian salmon industry, then the largest in the world, had to tow all their sea cages to open water to avoid massive algae blooms from overstocking of their coastal inlets. Chile is undergoing the same problems now. In the late 1990's, the Chinese shrimp industry production fell by over 40 percent due to disease caused from manure drift in the South China Sea. Because of instances like this, there is now a prophylactic use of medications and use of antibiotics is prevalent due to poor health industry-wide. Clear cutting of valuable mangrove swamps and coastal rainforests is rampant in Central America and other rainforest regions as farmers abandon ponds with disease rates that cannot be managed with medication. Thousands of acres of valuable mangrove swamps have been clear-cut for shrimp production, creating severe destruction to coastal ecosystems.

Soils. (Ch. 8). p.182

Soil is the hidden monster that's creeping up on all of us. We have lost two-thirds of our topsoil and agricultural production is dropping as we burn more forests to create more soil for monoculture. We can build soil, enrich our lives, and create oil-free agriculture.[20]

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20 INTERVIEW WITH GEOFF LAWTON,
NEW ORLEANS, 2004.
By Andrew Leslie Phillips.

Geoff was teaching a permaculture course in New Orleans when Hurricane Ivan blew in from the Gulf and we had to evacuate north. I took advantage of some down-time and interviewed Geoff on video. The DVD is available through Hancock Permaculture Center.

ALP: Let's talk about this hurricane – in class we've been hearing how the Mississippi has been changed over time by human settlement.

GL We're in one of the largest river systems on earth – an order two river – one of the top seven rivers in size and volume. It drains the Ohio basin - two-thirds of the North American continent's watershed catchment so it has an enormous amount of nutrient and silt-carrying capacity which at one time was distributed out on the river delta and the natural system acted as a filtration and sediment trap allowing for accumulation of silt, sand and soil -building up and distributed on every flood over millennia building up the soil/land level and therefore compensating for the natural tilt of the land level – below sea level.

For the sake of transport systems the river's been levied and extra canals and channels have been installed and the transport system is not in harmony with the natural flow of the river. But they could have been put in a harmonic pattern to actually enhance the distribution of the silt.

In fact, if we were clever enough with our harmonious designs we could put in patterns to increase the silt deposition in the landscape and raise the land level and design a transport systems.

But we can't break the rules of the patterns of nature and the energy flows that give us these deposits and its very hard to be in a position where you just don't affect nature - its negative or positive.

Its much easy to say lets totally harmonize and lets get an increased deposit of silt – it may mean a slightly longer track for the transport system but that doesn't matter if you've got beneficial landscape your traveling through - because its all harvestable production so we can't just look at the straightest possible route – the shortest distance between two points. In doing that we degrade the landscape rather than enhance it – we could have more to collect on the journey, more places to settle, and more people to transport goods too, so it all goes in either a positive or negative direction and right now its costing a lot of energy – even more to repair it, and there are very damaging affects on people and the landscape. There's no way around it, you have to bite the bullet and do it the way nature intended – you can't change that system

ALP: Hurricane – What could happen if it hits New Orleans

GL We've got a geological tilt, a large population living below seal level in the center of the city and in recent years an enormous amount of salt marshes have gone under the oceans and fresh water marshes has become salt marshes so the buffer, the natural buffer against the ocean has been depleted and the landscape has sunk and its only the engineering features in the landscape that are holding out potential storm surges and sea level rises.

There are all sorts of scenarios depending on where the hurricane hits. If it hits at the mouth of the Mississippi as an early season hurricane when we have a large amount of fresh water coming down the river from the spring thaw, it could be even more catastrophic.

At this point we are at the end of the summer so its not so bad be we could still have levees breach, we could have water draining out of Lake Pontratraine right next to New Orleans so there could be a reverse situation where the levees hold the water inside the city – 20 feet of water possibly- and it could take a long time to pump out.

I've heard figures of an inch in the first hour and then half-an inch an hour after that to drain the city and its not just the water. There is going to be organic matter and soil and silt deposited and there are lot of people that won't get time to leave the city and there's a lot of fatalities around that.

And this is the scenario that we know sooner or later is going to happen. Increasing the present system of heavy engineering and straight-line man-made patterns is not necessarily going to answer the problem.

ALP: What might be the permaculture solution?

The ultimate solution would be to start at the top of the catchment – at the top of the watershed and re-pattern the way water soaks into the catchment - from top down – that's a solution that's infallible. That will definitely work. We know that.

Its much easier to start at the top of the catchment and come down and then we know we've modified the pressure on the bottom of the river system – its hard to start at the bottom and work back up hill so the further up we start the more pressure we take off the mouth of the river. It means harmonizing with the contour patterns that are in the landscape – they are the patterns that shape the landscape, shaped by water. Round humid landscape shaped by water. So harmonizing with those patterns by installing soft-soakage water harvesting systems on contour and planting trees along the contour will moderate flow within the watershed and soak the water into the landscape. The same amount of water flows through the landscape but at a much more moderated flow so we get smaller droughts and floods and more of a continuous flow of water slowly leaking out of the catchment. Then you get a river mouth much easier to predict and control, which will absorb the variations in storms and climate that we are seeing and will actually moderate the climate over time.

Some of the catchment actually comes out of Canada – almost two-thirds of the North American land mass is the watershed of the Mississippi. If we can initiate this patterning of landscape – it would be quite easy to put in test case studies even over small areas – you can quite easily measure the water flow even off a small areas of

agriculture – you can measure the water flow volume and sediment and soil erosion in an area and the initial earthworks is just subtle civil engineering, much more patterned and harmonious than the present straight line systems.

Really they should be subsidized by the government because it will save the government a lot of money.

It can be done on any scale because the patterning is the same – it's a dendratic pattern – any pattern can be easily patterned – the same patterns as a tree as in a water catchment system.

When we get to the bottom land and flat country in the river delta we can actually study the engineering that's been done and we can look at what could have been done in the agricultural fields - flat country like rice and we can diversify the rice put in what would look like canals on contour with raised soil banks on the lower side – those patterns/structures/ excavations are actually there in the canal put in by the oil industry but they are very much a straight line grid pattern and what we need to do is to use the same engineering to put them in harmoniously with the agriculture and we can demonstrate how we can accumulate more soil and silt around the earth banks and contoured canals so we could start here as well at the top of the catchment – it would be an interesting and beneficial scientific study - save a lot of money and get a lot more sustainable production and end up in a completely sustainable catchment which would be a great for America and an example for the world. And it could happen quickly – we could get beneficial results and initiate that sort of landscaping throughout the whole catchment which would be a great example for the rest of the world.

ALP: Soil Erosion?

"The Hidden Monster".
Soil erosion is the hidden monster that's sneaking up on us. Enormous amount of soil erosion on the increase – and we don't seem to have an answer to it with conventional systems because most of our food is produced in an industrial agricultural way today and monoculture is the style of production and huge monoculture fields can't become sustainable by even going organic.

We've got to look at eco-systemic co-production – incorporate diversity into production – an interactive diversity which has to be economically interactive with the production of farmland. So we have to be very careful how we set up interactive diversity within farming country and we have to do that very fast because we are losing our topsoil at an alarming rate and most people don't see that even the farmers who are not much on-country anymore – they are very much in machines and governed by chemical input and agricultural research mainly aimed at modifying the genetics of our living systems to be more productive and not necessarily more sustainable.

It really needs to be something that mimics a natural system – bio-mimicry- the mimicry of ecosystems without losing too much productivity and without sacrificing the economy so really the way our food is marketed needs to be in a more diverse way - less of an energy consuming system – centrally marketed – we've got to look at decentralization of marketing, we've got to look at diversification of agriculture, repatterning of agriculture and it has be a concept that we take on pretty soon –

The loss of soils is the most potentially dangerous situation on earth – we cannot create new soils over a large area without partnering with eco- systemic processes and that can't be done with monoculture -small or large - and we're only getting larger so we have to look at eco-systemic polyculture, diversity of production and really a decentralization of marketing of food and its all achievable,

Its possible, its all provable, there is no problem – it can be demonstrated very fast and taught very quickly and spread throughout the world. The country that has the most potential to do it is America. We can do it faster and quicker and better than anyone else and we have the economy here to actually subsidize farmers to do it properly. And it's a system that will benefit most of the world and make friends with other countries in the world – we can demonstrate it here, train people to aid other countries to do it and it's the most economically profitable system that will ever emerge in the history of the world – it will make the Industrial Revolution look like a small-scale economic boom compared with what this potential situation has to offer in terms of what this has to offer the world's economies and America can lead the race because it has the potential to do it very, very fast. And that's what people don't seem to understand – they think we'll lose economic benefits but there is a gain of unimaginable proportion to the economy and unemployment will be something of the past – no problem – and way into the foreseeable future there is no problem with full global employment.

ALP: Building Soil – how quickly is soil being depleted and how quickly can it be replaced?

G.L: On average the globally traded crops all average 200 tons per acre of soil lost per year – soy, rice, maize, potatoes and wheat – they all average very, very large soil erosion losses per year – wheat up to 400 tons an acre per year and you can't keep doing that because you run out of soil which is your main resource and the only way you can recreate soil is through eco-systemic processes.

Our population is sky-rocketing at an alarming rate and its being allowed to do that on the current food production that creates that erosion so the only way we get more soil is to chop more forests and that moderates the climate over time and destabilization of climate through the enormous eco-systemic forest loss is making and increasing soil erosion and we're coming to a crash point and already in 2004, global food production is going down. So we're approaching this point where we can't keep up these practices.

In a good productive system where we've got eco-systemic inputs around productive fields we can loose four to six tons per acre a year and replace it. If we produce more we are gaining.

One can imagine getting into a situation where we are gaining10/20 tons of soil a year instead of losing soil and therefore we are enriching the landscape and have a potential to hold more water, hold more life and therefore get more production and reduce the size of agriculture and the amount of land we need to produce the same amount of nutrition that we now produce and let more and more land go back to wilderness and the wilderness has a sustainable production if we don't over harvest – more and more of an harmonic situation and more and more species start to naturally speciate. Instead of genetic engineering we can start to create situation where we can speciate more crops ourselves which will be more productive locally.

ALP: What is Speciation?

G.L: When we encourage species to actually develop a natural variation and then select for local production needs and they are more beneficial because they don't require so many inputs – originally there was one variety of corn but over 1,000 years in Mesoamerica different corns were selected, not hybridized or genetically engineered but selected for their particular qualities, produced locally for local soil and climate land needs and we've ended up with hundreds of varieties of corn.

We can encourage that action in all the species that we need to befit the local environment and this leads to a great diversity rather than a great simplicity of crops and an incredible amount of stability in local production.

As we teach those methods and create the conditions that enhance speciation then we become more sustainable and stable and endlessly enjoy it so long as the sun continues to shine we can be completely sustainable on Earth.

ALP: What is your background?
G.L: Over twenty years, since 1983 and I've been involved in a lot of teaching and consultancy and a lot or earthworks – I've been involved in a lot of countries where I've taught the first course within the country and the region, a sort of front line teacher where we go in and initiate courses and the first demonstration projects and that lead to involvement in a lot of initial earthworks

ALP: Talk about earthworks and soil creation.
G.L: I've become a teacher with a lot of experience directed a lot of heavy machine and done large earthworks projects where we've put in these initial large projects in just about all climate and every continent on earth – we're into the twentieth country where we've put in earthworks, taught and consulted.

My background was in mechanical and civil engineering so I was familiar with the type of procedures needed and very curious that the engineering that we really need to save the world's soils was something we could achieve and we have the technology and the equipment – American has everything we need to set these examples up – and we could/are/is the world's leader in these technologies and could be in a very short amount of time be the leader of sustainable water-harvesting earth works that re-pattern the landscape in an environmentally enriching way. Young people love it – they love the intricacies of the system

ALP: Why did you come to Australia and how many students have you taught?
G.L It,s in the thousands now – I have more than 2,000 emails in my alumni of students and I started teaching before people had email and a large proportion of them are active and involved in permaculture in different ways and that's the encouraging thing. Its no good teaching people unless they get up and get active and in what your teaching them – I have some great students out there – they are doing great work.

I originally was born in England and emigrated to Australia when I was twenty-five years old having married an Australian lady in England. I was an English surfer and I traveled as a surfer and I'd seen lots of agricultural processes natural systems as a traveling surfer and when I arrived in Australia I'd always dreamt of owning land and farming – I'd worked on farms but I never thought I could afford to purchase a farm in England – a small highly populated country – and when I arrived in Australia – its such a big country people, working people can afford to

purchase land and buy a farm, but acreage and set up their own farm and that encouraged me to get more involved in farming and I'd always been interested in natural and organic ways of farming - I'd watched the documentaries on television about alternative ways of farming and the old process of organic farming and I lived in farmland in the west country of England and loved the interactions in the old mixed farming.

So I saw the word permaculture around on the Sunshine Coast in south-east Queensland and I went to a meeting and a weekend permaculture course and decided this was something I was very interested in and I saw the course advertised in a grass roots magazine in Australia that it was being taught by the founder Bill Mollison in Tasmania so I took a couple off weeks the small business I was running and went down to Tasmania to do the course with Bill Mollison in September1983 and it changed my life.

I was well and truly infected by permaculture in a terminal way and that's how I like to think of my teaching – that I terminally infect people and they go out and infect other people with this different way of thinking and looking at the world and understanding nature a different way of thinking about design.

ALP: Some might say that permaculture is a ludite idea?
G.L: We look at appropriate energy conserving technology as great inventions but technology needs to be in the scale it is needed and what we need to achieve – its not going backwards to a luddite situation. The living systems that we have now can interact with now are global - the flora and fauna of the world are for the first time in the history of the world we have the possibility of using all the world's flora and fauna that's beneficial to us in any one location on earth and we have the most incredible technologies that can be put to use in beneficial ways – we just need to assess the energy that we gain from using the technology.

To be sustainable a system needs to produce more energy than it consumes over the lifetime of the system enough to maintain and replace that system.

So we can look at the energy used to produce technology so that the technology is produced in a way that it replaces the energy needed to produce that technology and maintain it and replace it over its lifetime. Its an energy audit – that's all!

So when you look at technology, one of the first things you need to look at is how much energy was needed to produce that technology – that tool, that vehicle, that computer, whatever and then how much energy does it save over its lifetime and can we replace the energy and we need to reduce that figure – its simple mathematics.

GROW SOIL
Permaculture is a system of design that allows nature to make the changes – it sets up design in such a way that nature starts to take up the gaps that we create - very quickly, its an opportunistic system that takes up gaps within systems and starts to benefit the landscape in general including the human landscape and settlement and very quickly it starts going in a positive direction building soil and nutrient and humus and the soil starts to repair and we are only just learning now how quickly that repair process takes place. It alarming really
The amount of water we can store in soils by terraforming and well patterned water harvesting systems are surprising how much water they hold how much water that accumulates in the landscape how much that can be

taken up by life systems how much life systems start to benefit the soils and then its really only the imagination of the designer that limits the possibility of the speed of repair – its very, very fast – we need to be able to design and take ownership of that design in a creative sense to be part of natural creation – don't be afraid of creation, of taking part in creating processes – be interactive with ecology instead of passive observers – we need to take lessons from ecology and educate the directive to act in an harmonious way and then we're out of trouble on a great path to absolute abundance that's where we'll end up – an absolutely abundant situation - permanent within human culture – it's a wonderful vision, a great vision and something you can see quite clearly as you interact with permaculture design over a few years of different landscapes and climates and cultures and get people to understand how they balance their actions in the world.

YOUNG PEOPLE.

As you train young people you realize they are taking up their positions of learning and understanding and you can only look at them as potentially very informed people in the future who will be able to see design very clearly ahead 30 or 40 years where I've only learned to design mainframe crude systems to start the process but some of these young people we're training after 30 or 40 years of design will be very special and able to design very complicated diverse systems – almost hard to conceive at this stage because now we can only lay out systems and watch the evolutions take place and then adjust our design in relation to that evolution and that's something that permaculture does it lays out systems and allows nature to evolve and we adjust our systems to harmonize with those evolutions that enrich and enrich

And we're learning as we do it and teaching people the things we're learning and the mistakes we make - and it's the most encouraging thing is the young people learning quickly and I can imagine their designs being quite incredible and productive and harmonious and awe inspiring.

FARMER TEACHER

Love to farm, love to be on the land – rather be on the land than teaching but we keep getting results and keep seeing students design well go out to help people all over the world and quite a few students become teachers produce teachers – so keep getting requests to teach so seem to be doing more teaching than gardening and farming – yeah love to interact with the land and feel its in the spirit and blood of my existence in some ways and often feel like it's the best classroom – for some people anyway, to be out there interacting with the land and we have a lot of requests for people to come work with us, volunteer to help on the land and working with young and older people with experience who volunteer to help – lay down demonstrations sites and evolve systems and we've come up with a few constant design processes that we now teach out based on those experiences.

TRAVEL

Equator was the first country taught in the Ecuadorian Amazon sponsored by a charity called Future Earth and it was a special course with 23 different countries involved in that course from Future Earth projects from around the world and I taught in the Brazilian Amazon and Peruvian Amazon and in between back to Australia – the Guatemalan Highlands and Denmark in a cold climate and then North American on the prairies with the Dakota people on Rosebud Reservation in South Dakota and back in Brazil for the Brazilian government test case course where we got a department of permaculture within the of Ministry of Agriculture, England NZ, Macedonia after Kosovo and Costa Rica, Mexico, Central Highlands of Vietnam, Louisiana – two or three courses, Jordan, Iraq for

the UN commission in Refugees, Egypt on the Sinai, Papua New Guinea after the tidal wave crisis in North west Papua New Guinea.

POPULATION

To initiate this process we really have to look at the human population as being positive rather than negative and we can teach that to children and its understood by them…

POPULATION 2

And we can easily support the world population – as it now stand and larger – population is not a problem when the human population has a beneficial effect on the environment.

Q: PERMIE COMES IN AFTER DISASTERS/JORDAN

It seems to be taken up very quickly where there is disaster and there is no hope left. I wish it wasn't the last system people call on – it feels like the system of last resort where nothing else works, permaculture works. And nowhere was that more obvious than in the Dead Sea Valley project.

We were working for a Japanese aid organization in partnership with the Jordan government and we were called in to see if we could set up a sustainable farming system in the Dead Sea Valley on 10 acres of almost flat, terribly salted landscape 5,000 parts per million salt in the soil and the only water we had to use was 4,100 parts per million salt It was definitely the last result after 2,000 years of abuse, over grazed, over cropped, over watered terribly arid landscape – only got six inches of rainfall a year I was very doubtful we get a result. We laid out a pattern on the landscape to harvest all the water we put in local and non- local pioneer tree species in with trees that shouldn't really grow in that salt and they grew – we put in a lot of organic matter – we put in curvy, wavy patterns that followed contour.

All the farmers trashed and burned their organic waste so tomatoes are harvested and then dried and burned, bananas are cut and harvested and trashed – all the organic matter was burned as it is in a lot of conventional agricultural systems.

We initially were given agricultural crop waste and after a while we paid farmers to supply us with organic matter they usually burned and we used it as mulch around in the water harvesting swales on contour and around our fruit trees and around our pioneer trees – quite thick – two or three feet thick initially - and that mulch saved a lot of water – it allowed us to use a minimum amount of water and the water harvesting swales which are really water harvesting ditches on contour with a soft decompacted mound on the lower side around which we planted our fruit and pioneer trees – they harvest any residual water left over from the drip-irrigation system which was placed under the mulch away from the evaporation and the pioneer trees grew really quickly and reduced the evaporation, created shade, reduced wind evaporation, produced nitrogen and supplied us with mulch later on and fruit trees grew that shouldn't grow and the Ag dept said it was impossible to grow figs and we grew figs and in four months some of them flowered and fruited, a year later some of them were six feet high and looked pretty good and a lot of wild life came in lizards and birds reptiles, mice, beetles and they all made deposits to our system – free nutrients and it became a site of refuge for all kinds of bird species bringing in their manure from a distance – high grade stuff bees all sorts came in and the Agriculture department couldn't understand how we could grow figs and they

said we must have washed the soil with a huge amount of soil but we documented how much we used and it was one-fifth of what they used.

21 Pollution is misplaced energy.
In U.S. 50% of waterways have too much mercury.
Acid rain – pH factor.
Rain is slightly acid – carbolic acid – parts carbon.
Heavy metals taken up in plants – plants are food pumps.
PH 3.5 dissolves aluminum – aluminum poisons all plants

Largest loss of soil is from salting. Can create a salt map – set up by Bill with school kids – Salt Action Liaison Teams. Salt meters distributed. Water is attracted to salt.

60 tons of worm castings per acre per year (Darwin) – creating the soils of earth with termites and rodents too.

Prairie dogs "call" for rain – positive ions produced by borrows. Positive ions create rain like tea leaves do – dogs live below ground Moon creates "land tide" and a respiration of earth at night – you can feel the breath of the night.

Sulphur – ph to acid
Calcium – ph to alkaline

Good soil is 5-7 ph
Can create up to 60 tons of organic fertilizer per acre.

SOIL COMPACTION:
Wallace plough
Yeoman's plough
http://lists.ibiblio.org/pipermail/marketfarming/2002-October/000127.html
Second stage of broad scale soil creation and creation of deeper soil to 18 inches with chisel ploughing. Creates soil is 2/3 years.
Kelp – 60 minerals and growth hormones.
Torrential rainfall on compacted soil – only about two percent of water will penetrate.

After 3/4 normal rains a farm should be drought proof as you reach 100% saturation. Enormous yields result, up to 80 times for banana circles and you can fill the village wells in three years. There is more life below the soil than above it – earthworms/compost worms/forest worms ups to 18 inches long in Gippsland.

In deserts we get ant hills and termites – about 18% of rainforest leaves go through ant leaf-cutter process. Rye grass has 129 kilometers of hair root. Carbon/NPK/12 minor elements/25 trace elements/50 minor trace elements.

Synthetic fertilizer – NPK plus cadmium salt. They feed plants limited nutrition, encourage growth and bloating makes plants more attractive to pests and more susceptible to fungus.
Response to damage soil is weeds. We try to feed the plant and not the soil.

Fungi nets, mycelium

Plasmic streaming – fast carbon pathway, carbon harvesting from the sun.

COMPOST – BERKELY METHOD.
If it has lived it can live again.
Nitrogen is the explosive element at ratio 1:23/30 parts carbon

RATIOS

	NITROGEN	CARBON
Saw dust	1	500
Fish	1	7
Chicken manure	1	12
Cow manure	1	18
Grass, green weeds	1	25
Urine	1	1
Newspaper	1	150
Straw	1	

One third manure/2/3 carbon by volume plus water – one cubic meter – about three hours work turning.
Activators – animals, fish, comfrey, yarrow, nettle, urine
Max temp 50-70 degrees C.

SEED MIX
1 part compost to 10 parts sound.

WORM FARMS
1/3 organic
2/3 manure
they eat their own weight every day and create castings.
1,000 worms will double in a month, in 12 months, half millions worms.
They love watermelon and mango.
Worm juice will sell for up to $8 per liter
Worms don't like citrus, onions, garlic.
Burn citrus it is high in potassium and potash.

Vermiculture.
Biological indicators.
Erosion and rehabilitation.
Compost.
No- till and sheet mulching[22]
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Earthworking and Earth Resources. (Ch. 9) p.227
Permaculture works on all natural scales and heavy equipment can greatly accelerate positive effects on the landscape. Property land-forming, dams, ponds and introduction to aquaculture, water-shed management.
Planning. Levels and contours.
Keylines, dams and swales.
Equipment. Earth resources.
Planting and reforestation. I
infrastructure placement and protection.

MODULE 4.
CLIMATE ZONES AND DESIGN STRATEGIES.
The Equator and five circles of latitude, longitude and time zones, equinox and solstice
The Humid Tropics. (Ch. 10). p.250
Soil is least available in the tropics where most biomass is above ground in the forest. We can create dense food forests and water harvesting systems while protecting our home from natural elements like storm surge, hurricanes, fire and flood. Natural cooling systems and habitat design.

Wet tropics, wet-dry tropics, monsoon tropics. Tropical soils. Earth shaping in the tropics. House design.[23] Tropical home garden. Polycultures. Sea level rise.

Dryland Strategies. (Ch.11). p.308
More of the world is becoming desert as forests are destroyed, rain patterns change and animals scour the ground for food. Soon nothing is left. We can apply simple principles to make the desert bloom again.

Precipitation. Temperature. Soils. Landscape features in deserts. Water harvesting. The desert house. Earth homes. Desert garden and irrigation. Animal systems. Desertification and

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22 CHICKEN TRACTOR

2 weeks in each cycle – cycle chickens through sections. Movable use poly pipe approx 12 ft, diameter, 3 ft. mulch compost – approx 5-13 chickens. Will prepare space for 3 fruit trees, 4 legume trees, 50 legume seeds, 20 root divisions, 100 sweet potatoes cuttings. Technique is on one dimension. Strategy is in two dimensions.

23 TROPICAL HOUSE

No thermal mass. Sun should not touch the wall. Heat moves towards cool. Evaporation cools. Condensation warms. Orientation to the wind. Full shade of possible. Insect screenings. Roof water catchment. Dry compost toilet. No septic tank – too much rain will bring septic to surface.

ARID

In desert usually sufficient gray water to feed family garden. Should be no west windows.

Paint sun facing walls white and shade with trellis crop and evergreen trees Shade will produce cooler air. No more than 50% windows on cool side.

Salination.

(Ch. 12). Humid Cool and Cold Climates. P.411
Home heating and energy consumption are big issues in these climate zones. Understanding some simple constants like the sun always shines from the equator, will save you a lot of money in home heating.

Habitat design, food supply, water and soft energy principles including attached greenhouse, passive solar hot water systems and co generating woodstoves are explored.
Characterists. Soils. Landforms. Water. Settlement and House design. Home garden.[24] Food

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24 100 sq feet will feed a family . Modern agriculture provides no processing equipment for small farmers. Japan, Italy, India have equipment

35 acres feed 100 families in Japan doing it all with ducks "The Power of Duck, Takao Furuno.

"Square Foot Gardening" Mel Bartholomew. Rodale

www.tagari.com/item.php?itemid=5

Michael Guerra is the author of The Edible Container Garden, it is available from Permaculture Magazine's Earth Repair Catalogue, priced £11.99 www.permaculture.co.uk/mag/Articles/10%20Years%20After.html

"We remember those early (before children!) years as particularly fulfilling from a personal growth point of view. We were able to grow, in one good year 550lbs of raw unprocessed food from 800sq.ft, the equivalent of 13.5 tons per acre.

Most of it was annuals grown with every intercropping, stacking and season-extending method we had to hand. We were importing about a ton – 2,000 lbs - of well-rotted horse manure a year (a lot of that was for building up the poor soil), and making plant feeds from comfrey, nettle and urine. It was a good time. I was mostly unemployed (Julia was working for some of that time – though we were both unemployed for a year). We spent time growing together, enjoying each other's company, reading and having lots of visits from folk from all over the world."
Domestic Food Security
Water

COMPOST
I part nitrogen:30 parts carbon

Pine needle mulch for strawberry, blueberry – soil from under pines.

WATER
Acidity – add limestone/oyster shells to correct pH – one cubic meter per 1000 liters.

Forests. Livestock. The lawn[25]. Grasslands. Soil compaction. Rangelands. Cold climates, snow and ice. Fire protection. Alternative energy systems for heat and cold. Solar.[26] Diversity and stability.[27] Alternative building models and techniques.[28] Wood stoves and wood lots. Co-

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Rainfall at 4.5 dissolves stuff to colloidal dimensions for plant infusion.

ACID 1 – ALKALKNE 13 – NEUTRAL 7 – logarithmic scale

Garden best at 6.5 and in damp wet climate, 6.2 pH.
At 4.5 pH heavy metals dissolve – zinc, cadmium, mercury
At 3.5 aluminum becomes water soluble and is 100% poisons.

Trees will put out alkaloids to themselves from Aluminum but within five years they will die.

Electricity comes from sulphourous coal which creates acid rain-Dutch Elm disease.

25 LAWNS

Permaculture questions current methods of agriculture – lawns for instance, do not permit the chaotic intrusion of vegetable gardens – since vegetable gardening smacks of poverty and peasants and the new middleclass were loathe to dirty their hands.

In the U.S. lawns are the largest "crop" system we have expending more energy than corn and vegetable production. And the "yield creates a massive public disposal problem because cut grass is usually saturated with petro-chemicals.

Millions of gallons of gasoline are used cutting grass and lawn use up to one-quarter of annual fertilizer production – equal to the amount used by India - lawns create a negative energy flow - they are not good at water storage - the petrochemicals we use to make lawns lush and green, run-off and eventually pollute the water table in the same way as large-scale food production and its use of chemicals ultimately poisons the landscape.

California, a water starved state, uses almost half of domestic water consumption on lawns. For every lawn we could have another benign crop – we could grow sufficient vegetables to feed the country on our lawns.

To reform lawn culture, permaculture suggests new business opportunities – lawns need lots of sun and so do vegetables and trees.

26 R value

R2 means if temp. drops outside house it will take 2 hours to change temp inside house.

STRAWBALE is R60

27 Diversity and Stability
Useful – connections between elements
Interactive diversity leads to stability

generation and heat transfer. Mass ovens, clay and stone. Working with stone. Greenhouse construction. Straw bale construction. Greenhouse gardening for food and warmth and shelter.

MODULE 5.
AQUACULTURE, INVISIBLE STRUCTURES.
Aquaculture. (Ch. 13). P.458
Water provides more than 20 times protein per acre than land. Fish is a great unused resource and waste water gray water systems relieve the burden on sewage systems and provide nutritious water for gardens and aquaculture.

Stability leads to fertility and fertility leads to sustained productivity

Productivity can be designed into systems seeking a sustainable economy.

Economy is designed sustainability and interactive community

Permanent culture through inter activity.

28 HOUSE PLACEMENT AND LIGHT – SUN ROOM

Latitude = % of glass on sunny side of house.

Therefore at latitude 40 degrees, 40% of wall should be glazed.

TEMPERATE HOUSING

House suitable for 30-70 degrees within 15% of sun direction with no west windows.

Heat will remain under house if insulated down 2 feet around foundation. Isolate large mass (stone) in floor.

Consider wool insulation, sea grass (it will compost in 10 days), wood chips and shavings, jute.

Super insulation may incur radon problems. Leaky house is good house.

Earthen floor – tamp and leave 2 weeks and it will harden and crack then add

Blood/clay/soot with raw linseed oil in cracks or fresh sloppy cow shit and albumen will bind clay.

CONVECTION – heat the air but air is great insulator and is difficult to heat.

RADIATION – heat radiates in every direction and heats solid bodies but does not heat the air.

CONDUCTION –

Underground house plus or minus 5 degrees. Test for radon.

MUD HOUSE – one part mud/lime/chopped grass in sloppy mix and pour into form – go up about two feet a day.

Sawdust/sand and cement – sawcrete

R value 46 – i.e. 46 hours after temp changes outside it will change inside.

Dams, ponds, Chinampas. [29] Yield beyond the pond. Gray water and reed beds. Polycultures.

Strategies for an Alternative Nation. (Ch. 14). P.506
In this time of energy descent we will need to travel less and live in closer commune with those around us. Food supplies will need to be local as will all our basic services. How can we design robust systems that integrate permaculture principles into the bio region and beyond?

Ethical basis. United Nations. Local government. Bioregionalism and community. Extended

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29 AQUACULTURE

Pond 3 ft deep as big as lecture room, 25 ducks, green algae is prawn food

Raised Pond may be up hill from other systems and populated with birds – manure water will overflow.

Cow food – Alfalfa, bran, chopped legume, comfrey, bamboo (will clean leaves off trunk), cannas lily.

1 tspoon copper sulphate to worm cows
1 Tspoon animal dolomite
1 Tspoon flower of sulphur
Rock minerals
1/2 cup natural kelp
1/2 cup organic apple cider vinegar
1 dob molasses

Manure now has all this included.

This mix also good for chickens and dogs.

Mugwort reduces arthritis and is a legal high and grow only from cuttings and looks like marijuana.

Wormwood (Absininth) tea de worming

Five Acres cost $8k in earthworks
Angle bucket excavator (25 ton)
D7 dozer

Hydro mulch mix with seeds with binder

Best weather to build dam is in moist weather – cattle will compact dam over time and manure will help seal it.

Carp is most eaten fish in the world.
Silt trap systems, gravel paths, water chestnuts

families. Invisible structures. [30]Trusts and legal strategies. Eco villages. Currency and barter. Land access. Ethical investment. Catastrophe preparedness and prevention.
Food and water security.
Rising price of oil and energy.
Farming for food security/market gardening.
Food storage strategies.
Aspects of eco-village design.
Community.
Invisible structures.

Where do we go From Here? (Ch.15).
Planning for the future.[31]

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30 INVISIBLE STRUCTURES

Trusts – buy a small company/failed company for less than cost of setting up new company for about $1,000. A document with manifesto and statement of purpose.

FORMAL AND INFORMAL ECONOMIES

Credit Union – can make up to 28% on capital with savvy investment of funds. Ethical investment.

LETS (Canadian)

http://en.wikipedia.org/wiki/LETS

Local Ethical Trading System has become international system.

Grameen banks/informal economies

Promissory notes – Issue say 1,000 $100 notes ($100,000) with expiration date. No interest paid on note. All Mollison's books published on promissory notes.

31 The Application of Permaculture

How permaculture is used varies widely depending upon the site, its intended use, and what resources are available. The one thing that all permaculture sites will have in common is moving in tandem with the Ethics Of Permaculture. Amidst that container, there are many different techniques and technologies:

Gardening and recycling: edible landscaping, keyhole gardening, companion planting, trellising, sheet mulching, chicken tractors, solar greenhouses, spiral herb gardens, swales, and vermicomposting

* Water collection, management, and re-use systems: Keyline, grey water, rain catchments, constructed wetlands, aquaponics (the integration of hydroponics with recirculating aquaculture), and solar aquatic ponds (also known as Living Machines)
* Energy saving (appropriate) technologies: Solar and wind power, solar greenhouses, composting toilets, energy efficient housing, and solar food cooking and drying
* Farming systems and techniques: agro forestry, swales, contour plantings, Keyline agriculture (soil water management), hedgerows and windbreaks, integrated farming systems such as pond-dike aquaculture, aquaponics, intercropping, and polyculture.

Networking
Media and outreach
Long term city planning.
Energy conservation.
Community education.
Community communications.
Low power FM radio, shortwave CB radio.
Local government and feedback.
Course feedback.

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