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The MONTECRISTO Plan.

Coffee Development Blocks for the Trifinio!

Coffee, the Catalyst for Rebuilding Tropical Dry Forest Areas

Some Ideas and Outlines for Production Management.

Ken Calvert.

Renertech Research.

Summary:

This paper provides some suggestions for using coffee as the catalyst or incentive to regenerate sections of previous tropical dry forest in the buffer zone around the Montecristo Cloud Forest, the high point where the lands of three Nations meet. Guatemala, Honduras and El Salvador. This system should minimize on the erosion of this drier stony country and stop surface runoff pouring tonnes of spoil into the rivers. However it could be useful anywhere in a dry forest zone.

By using time, and encouraging the local population to help themselves, the catchment areas of the rivers, particularly the Lempa river, can be contoured by permanent terraces of Vetiver grass, with coffee and other produce grown on the terraces and a two story system of shade grown over the top of the terraces, using selected trees that cater for the needs of both the natural fauna and the local population. It is impossible to cover every possible situation, so it is the worst possible case that is used as the example in this document. The suggestions made here, could be carried out by a Manager seeking to regenerate an old full sun plantation, or a denuded cattle ranch, and/or by a co-operative group of small farmers each working their blocks individually. A Co-operative is the quickest way to get control of assets and access to credit. The major part of these suggestions however, apart from a series of demonstration blocks, is a motivational program

through local Cadres to help the people help themselves. Most of the suggestions given are well known systems, both old and new, and the Internet abounds with information about each of them. It is the combination of these well proven factors rather than any unique approach, which comprises the value of this 'Specialty' Coffee system.

'Quezungual', 'Milpa', 'Terra preta', 'Swidden','Vetiver', 'Leucaena', 'Alley cropping', 'Pole cuttings', 'Bio-char'. LEISA!. 'Conservation Agriculture', they are the names of the game! Quezungual, the local technique of 'slash and mulch', has done much to transform the landscape for growing the traditional corn, squash and beans, but so much of that is subsistance agriculture. To develop a cash flow economy that will pay for school fees, better tools, simple machinery, and a better lifestyle, a further step of terracing is required, to begin the slow process of transforming steep slopes into steps and stairs and enable them to hold back even more water. By making coffee an intrinsic part of a new/old way of life, better processing techniques, ie. updates on old ones, can be included in the overall package to raise the quality of their production into the 'Specialty Coffee' sector, thus maintaining a continuing overseas interest in the present plight of these people, and maximizing their income from coffee. .

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The International Trifinio Plan:

This overarching Mega Plan, now running for over 20 years, involves the collaboration between three Countries, Guatemala, El Salvador and Honduras, assisted by the U.N and other International Agencies.[1] The aim is to improve;

a/. the lifestyle of the population;

b/., the erosion and denudation of the landscape;

c/. the resultant water quality of the river systems, especially the Lempa river, and do it all in an environmentally friendly way which will enhance the local flora and fauna of the area.

This particular paper outlines a strategy **whereby the International Coffee Industry** can participate by implementing a series of small strategic demonstration projects, based on various facets of this general outline, which will not only encourage the planting and processing of high quality coffee as the ultimate long term source of cash flow for the peasant population, but will also enhance the sustainability of **their future heritage.**

The Montecristo Cloud Forest is the centre piece of the development:

This Massif is the high ground, up to 2,400masl, where the borders of Guatemala, Honduras and El Salvador meet. An environmental heritage, it needs to be preserved as it is rather than exercising any thought of 'developing'it. What it really needs is a buffer zone around it. A zone of land and people who are not so tempted to rape the cloud forest because they can get most of what they need from their own regenerated resources.

The Surrounding Tropical Dry Forest Zone:

These lower areas , from 800 metres or so upwards to the cloud zone, have supported human habitation for a very long time, albeit on an intermittant basis.

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1 http://unesdoc.unesco.org/images/0013/001333/133304e.pdf

However it is only since so called 'Western Civilization' caught up with 'Meso-America', that all these problems have surfaced once again, now in our lifetimes.

Dry Forest is defined as; " An area with a pronounced change in climate between a shorter wet season and an extended dry season, which can have little or no rain for up to 8 months." [2] In the Trifinio, the wet season is from May to October, and despite an annual precipitation of 1-2 meters in that period, during the remaining 7 months the lower country below the cloud line has to survive on little or no rain at all. So much of this country, surrounding all sides of the Montecristo, is seriously denuded and the steadily increasing population is putting additional pressure on the local environment. Heavy rains during the wet season have caused an increasing amount of erosion on soils left increasingly bare by poor agricultural practices. So, the central 'Cloud Forest' may be the focal point, but it is regeneration of the surrounding lower altitudes within the arabica coffee zone, and improvement of the lot of the peasant population living there, that is necessary to keep those rivers flowing out from Montecristo to be clear, non polluted, and fit for use by all the towns and cities down stream.. There is major concern that the hydroelectric dams on the Lempa river are silting up at an alarming rate.

Soil Erosion and Water Pollution:

Once bare dry soil has had its surface compacted by heavy rainfall, it becomes like a waterproof coat and instead of water sinking into the soil reservoir, the rain becomes surface runoff simply gouging out gullys and ravines on the hill sides, pouring eroded soil and pollution into the rivers and filling up the water storage volumes of hydroelectric dams downstream.[3] Therefore, any coffee development projects should be looking at these denuded hills and working out ways to regenerate them into fertile soils once again. Rainwater has to be held up on those upper slopes of the river catchment areas long enough to be given time to sink into the ground and bring the water table back up to the point where plant roots can reach it again. Those roots will then open up the soil and rebuild it into a water reservoir which can maintain moisture levels far past the end of the shorter rainy season and minimize on the length of the dry season.

Time is of the Essence:

This can be done with natural 'organic' biological processes, but it takes either time or money, and nobody has any money! What is required therefore to make the time factor bearable, is to plan out a sequence of events that will start improving the lot of the local population long before new coffee crops will come into bearing and a "coffee cash flow" can be established. Roland Brunch, the Guru of this kind of development,[4] says the first discernable improvements have to be seen within 12 months! Furthermore, the time factor and the work involved should be seen as investing 'virtual' money in the bank, creating a heritage for the future generations who will be making a living on that land. We don't only sell this package on behalf of the big cities, we sell it as improving the way of life. of the people up there. It is unfortunate that land tenure is so often insecure, and so politics is a major problem. Is a tenant allowed to plant permanent trees on his lease? A Co-operative structure is the quickest way to access the ladder of opportunities created by Hernando de Solo Polar[5] An Organisation can get away with a lot more than an individual. Is a

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2 http://www.worldwildlife.org/wildworld/profiles/terrestrial/nt/nt0209_full.html
3 http://en.wikipedia.org/wiki/Cimarron_Hydroelectric_Power_Project
4 http://srdis.ciesin.columbia.edu/cases/honduras-007.html
5 http://en.wikipedia.org/wiki/Hernando_de_Soto_Polar

Plantation Manager prepared to let his tenant workers run their small animals on the plantation itself? We can only do the best we can under all circumstances.

Recent Changes:

Since this paper was originally written in early 2006, there has been another 'Oil Shock' which has escalated the price of those grains which can be fermented to make fuel alcohol. Previously Central American Governments could keep their urban poor going on subsidised cheap imports of grains from the U.S.A. This meant that the local price of corn for instance was not high enough to encourage peasants to really grow corn anywhere else than along the Carribean coast where rain fall patterns are more even all year round, and two crops a year are possible. Despite the tremendous effort of the Lempira Sur district to support the Nation with Milpa raised Corn, Squash and Beans, after Hurricane Mitch in 1998, prices had slowly dropped again to make the work drudgery rather than achievement. Now however, as of February 2010, the price of corn has quadrupled to 400 Lempiras/Quintal. For those people who squat or rent their land from year to year on uncertain tenure, if they could get two crops of corn a year instead of one, then they could increase their cashflow without the time lag needed to establish tree crops like coffee. It would also appear,[6] that with the increased price of seeds and fertilizers etc, only one crop a year, is not sufficient to give a better return than coffee. Nevertheless, it must be pointed out that the suggested improvements for coffee, in particular improved moisture retention through terracing, can improve the returns on other annual and biannual crops as well, and through this kind of project two crops a year of food grain staples may well be possible. However, for the sake of brevity we will henceforth stick mainly with coffee.

Regenerating Leached out Soils:

One point that should be made clear to Environmental and other Lobby Groups who may hold up their hands in horror that we may be decimating natural forest to grow 'fancy' coffee, is that this scheme is mainly for upgrading old existing 'sun' coffee blocks, or for regenerating old 'slash and burn' garden land or old cattle country where there are very few trees remaining. It is all about recreating a new kind of dry forest with selected species that will not only do all the things that the 'armchair people' would want it to do, but it will also care for the people on the land. As well as the migratory bird life and farm animals, it will also satisfy the 'Specialty' Coffee people who want 'Organic' organic coffee with bold AA beans and a decent flavour. That is something that 'naturally grown' small holder coffee can rarely if ever achieve.

Organic Labeling:

I believe that it is better to use some fertiliser in the first instance and start growing good coffee and get some cashflow first of all. Then, if one wishes they can change over gradually to a higher value Organic agriculture. Most Certifying Groups will want to monitor progress for three years or more anyway, so there is no point in working hard to make the changer over before one is committed to total 'organic' practices. I can only say that I am not at all enarmoured with those Organizations that preport to certify 'Organic' coffee at some cost!. The basic definition, as given by the National Organic Standards Board is not all that restrictive[7], and its basically a case of picking the cheapest and closest authority to home. It is much better to look

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6 Personal Communication. Mario D.Alvarado.

7 http://www.ota.com/definition/nosb.html

to something like the 'Sustainable Agricultural Network' which is jointly managed by local 'In Country' Conservation Groups.[8] Or The 'Certified Naturally Grown' organization for the first few years until product levels are well established. Once a farmer Group can produce 'good' coffee, and it is checked out by the local SAN Organisation, the importers and retailers that buy it will put their own labels on it, at no cost to the poor producer.

Building Vetiver Terraces:

One of the first actions by any Government Authority or Development Agency wishing to encourage this sort of regeneration of denuded dry lands, is to make sure that as well as seed banks there are also plant nurseries available for initial distribution of useful species to recreate this better environment. If no nurseries are available, then they must be created using selected local groups or Co-ops to set them up. For strategic plants like Vetiver, Leucaena, Arachis and Casuarina, and for strategic technologies like Alley cropping and LEISA, there are already existing NGO specialist agencies doing good work in the area. They should be encouraged and used, wherever possible, to maximize the expertise having potential input into a coffee scheme. Furthermore those organizations will have a much longer life span and support base than a 4 or 5 year development plan. Arachis pintoi for example needs special treatment with coffee. (see basic details as given below).

First on the list should be an adequate supply of Vetiver grass slips.[9] Then, without disturbing any coffee or other existing trees, lines of vetiver grass should be planted across all the gulleys starting at the top, and planting in horizontal lines around the contours at intervals of 5 to 10 metres apart down the slope. These lines do need to be level, but they do not need to be totally accurate. If there is a tree in the line of fire, then take the line of Vetiver around behind it. Just make sure that the slips are planted continuously 100mm or so apart,[10] and that any holes or gaps that appear later in the line are filled with replacement slips.

Showing how its Done!

In particularly steep areas or in active ravines plant extra short sections of Vetiver every metre up the face and in between those main rows which will eventually become the bulwark or face of the terrace which will gradually form behind them. The extra short sections can be removed later when they are no longer needed, the rootstocks divided into small slips and recycled in other areas. The first field day at the Nursery site should be demonstrations on how to propagate your own Vetiver slips. That doesn't take any money at all. Where terrace buildup is slow, the Vetiver may just grow outwards rather than upwards. If the band of growth becomes too wide and takes up too much horizontal ground, use a sharp spade to wrench out the extra width and allow the plants removed to be recycled as above.[11] Initially there will be washouts under heavy rain, but persistence will bring the reward of seeing all ones own valuable top soil not being lost downhill, but getting spread out sideways to create the beginnings of flatter terraces, as the vetiver grass walls make a porous dam which not only filter the water and slow it down, but also hold back everything solid and so build up a level bank of loose soil and debri behind their rampart. That wall of embedded Vetiver rhizomes will steadily extend higher and

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8 http://www.rainforest-alliance.org/agriculture.cfm?id=san_members

9 http://picasaweb.google.com/VetiverNetwork/CaliforniaApplications#

10 http://books.google.co.nz/books?hl=en&lr=&id=tuCpD7Yv6T4C&oi=fnd&pg=PA2&dq=Vetiver+terraces&ots=Sxo88RLJAO&sig=PGIzg53UsnobtBySWHJZayywJIM#v=onepage&q=Vetiver%20terraces&f=false

11 http://www.vetiver.org/FIJI_15.htm

higher vertically back up through the accumulating terrace of soil by their unique backwards tillering action, to ultimately create a series of walls and terraces right back up the hillsides. The Internet.[12] is a ready source of information on how to do this.[13]

Ground Water Recharge:

Such terraces will not only become fertile soil, but they will also hold back water and lots of it.[14] Groundwater recharge is a vital requirement for development.[15] However, Vetiver is as strategic under the ground as it is over it. Most of the soils in this area are shallow stony 'entisols', and building rock walls to create terraces is a good way of using up the stones. However, vetiver is better than stone, in that the vertical roots of vetiver can go down several meters, far enough to latch into the rotten rock crevices at depth and hold up against those large land slides which can put tonnes of spoil into the river systems. The structural and shear strength of vetiver roots, several metres long, is well documented.[16] Then, as the soil gradually falls away from the toe of each terrace above it, the rocks that keep getting exposed can be moved accross to buffer the base of each main mulch producing vegetative terrace. On steeper slopes one should not think about growing ground cover such as perrenial peanut, until substantial movement of loose soil occurs to level up the terraces. Such strategic structures will more than likely be improved by passing through the property of several landowners. So, there has to general consensus, to make sure that everyone is aware and agreeable as to what is going to happen. For that, demonstration is the major educator.

Compromise is the Name of the Game:

Unfortunately for some people, the directions of those contours on their land may be all wrong to take full advantage of the direction of the sun, prevailing winds and the boundaries of their small holdings in relation to other peoples land. The initial lines of tall straight up trees, for initial shade and more particularly for shelter, greatly reduce the evaporation rates of the prevailing winds and so help to conserve moisture. Surface mulch is good for reducing evaporation, but it will save a lot more water if it doesn't have a prevailing wind blowing steadily over the top of it. Those tall trees will break up wind into small eddy currents, with little or no velocity component.

All decisions made from this point on involve lots of compromise to try and make the best of a less than optimal situation. However, those contours and the subsequent drainage patterns have to ultimately come first. They will also gradually take precedence over existing systems, coffee trees, fences and drainage runnels etc. This does not mean that the farmer has to wipe everything that is in the way and start off with a "clean slate"! Life has to continue and food and money have to be earned during the 5-10 years that it will take to make the gradual changeover. If a precious fruit tree is in the way of a line of Vetiver, just plant around it and leave the tree. Maybe 10 years down the line the tree will need to come out, but by that time it will be obvious that there will be no further need for it then anyway.

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12 http://www.vetiver.org/KUW_WORKSHOP_papers/KUW_5JG.pdf

13 http://www.vetiver.org/KUW_WORKSHOP_papers/KUW_5JG

14 http://www.vetiver.org/ENG_Engineering15.htm

15 http://vetivernetinternational.blogspot.com/2009/04/vetiver-systems-for-groundwater.html

16 http://www.greenfueltech.net/vetiver.htm

Similarly, coffee trees can be transplanted.[17] [18] The evidence for this comes more from amateur gardeners than from professionals, but if a good coffee tree is in the way of a terrace, or the roots are becoming exposed or buried by soil movement on the expanding terraces, then at recycling time, as well as cutting back the stems, a sharp spade is used to 'wrench' the roots back about 150mm from the stem, without moving the tree. Once again a long narrow 'drainage' spade can be angled in to get the tap root. Then after about a month, or just before new shoots appear, the whole tree stump can be dug up with its root ball intact and replanted. It may take two seasons rather than one to have it flowering again as a mature tree, but that is still a lot faster than planting young seedlings. Small Farmers do not like losing coffee trees, and terracing is not about losing good trees.

New Varieties or Old:

90% of the new varieties of coffee are bred for disease resistance rather than productivity or flavor. And I would be most reluctant to encourage farmers to root out all their old coffee just to plant new, unless disease is a problem. The big difference between good and poor quality coffee beans is in the way it is cultivated and grown. So, if there are no problems with disease in the area, then one should initially encourage farmers to recycle and if necessary, transplant the trees that they may already have, which will come into bearing years quicker than fresh seedlings, and only then move onto better varieties as the need arises. However, it often takes a full season of demonstration to get small farmers to really recycle their trees with complete removal of all the major stems leaving only a small 'lung' branch, let alone think of transplanting the stumps as well.[19]

Planning for the long Haul:

Much has already been done in the Lempira Sur district of the Honduras to revitalize agriculture by swinging away from the old 'Milpa' or 'Slash and Burn' to Quezungual, (or Quesungual), or "Slash and Mulch".[20] In less than 15 years, Quezungual has done a tremendous work to revolutionise agriculture on steep hillsides[21] ' But now some critics are saying that for those who have embraced it, production has plateaued and they are looking for additional ideas.[22] But slash and mulch' is not the end of the road! The last section of this presentation [23] asks, What is Next? That is what we seek to answer!

Beyond Quezungual:

By improving on the basics of slash and mulch agriculture, incorporating the best of Alley Cropping, the decaying root systems of Milpa/Swidden, terracing and

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17 http://davesgarden.com/guides/pf/go/2057/

18 http://www.molokaicoffee.com/cart/shopcore/?db_name=molokai

19 see Calvert, "Growing Specialty Organic Coffee".

20 http://www.fao.org/FOCUS/E/honduras/agro-e.htm

21 http://www.biology.duke.edu/aridnet/wkshop_quesungual/pdf/Quesungal._____2002_LEIS.pdf

22 http://gisweb.ciat.cgiar.org/wcp/download/Theme2_Summary_Project_Activities_2005.pdf

23 http://www.youtube.com/watch?v=horRP7-2Gyk

Soil Microbiology, a further series of steps can bring in another series of lifts in the local economy and a better future for the next generation. And, because it will also reduce soil erosion problems then the whole country will win as well. The carrot on the stick however is 'Specialty' coffee.

'Specialty' organic coffee is revitalized traditional coffee, and it sells for a substantial bonus and an increased cash flow, when traditional smallholder coffee will not sell at all. However, the growing part has to be done 'right', and it has to be marketed through a Co-operative, or some grouping of Coffee smallholders to get sufficient batch volumes. Minimising on the shade and maximising on the moisture and soil fertility will give bigger bolder beans that will bring premium prices above 'naturally grown' or 'rustic' organic coffee.

Organisation:

So many failures of very good schemes are caused by 'Development Agents' who want to see some results before the end of their relatively brief contracts, and they press for instant action. When people are close to the breadline, one wrong move can cause starvation and catastrophe. The most important initial factor therefore is a thorough demonstration and observational program for the landowners themselves. Not so much with meetings and discussion groups, Latin America is not at all like East Africa in that regard, but with field days and visits to the nearest plant nursery set up by their project, to make sure that not just the farmers, but also their sons, are clear in their minds as to how long it will take and what is the sequence of events that they and not the Change Agents will have to follow through on! Again, according to Roland Bunch[24], this is not an easy task! Farmers can so easily get sick of visiting 'do-gooders'. Then there has to be the demonstration area, that everyone can see and evaluate for themselves. Brochures and papers on the plan are also necessary, but they are only backups and reminders to those who have already made their decisions on the basis of lots of observation, argument and public discussion. All that a Funding Agency can do is to set up some demonstration areas, and then train up the trainers, who will be judged on how they keep those/their observation plots going. They are also the ones who have to spend the long hours of debate required to hammer out a consensus of opinion. The positive feedback for those agents, if they are the innovative farmers as well as the 'change agents', is not only the meagre pay they will receive, but also their rise in status within their own communities. That means that the Expat Innovator does not undercut them. He sits down with the rest, watches his 'bright boys' do the talking, and then quietly encourages them and maybe corrects them later in private.

Growing Alley Lines of Tall Trees for Shade, Shelter and Profit:

At the same time as the terraces are being generated around contour lines, plans should be made to grow lines of straight tall trees, 5-10 rows of coffee apart, aligned against the prevailing winds, and also to be end on to the sun, during a period of no more than two hours, some time during each day, avoiding the midday heat if possible. For good coffee it is necessary to have 'sun leaves'[25] on the coffee trees and that requires a short period of full sun each day, and then enough shade to allow the roots time to catch up on the leaves. Coffee grown under total shade has thinner paler leaves [26]which can only make 'naturally grown' coffee which lacks so many of the the quality factors.[27]

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24 http://srdis.ciesin.columbia.edu/cases/honduras-007.html
25 http://www.jstor.org/pss/2474694
26 www.plantphysiol.org/cgi/reprint/72/3/674.pdf
27 http://www.publish.csiro.au/paper/PP9940207.htm

Overbearing dieback is caused by overloaded roots, not by too many leaves.[28] The most important factor therefore is mulch, Mulch, MULCH! Those roots have to be kept cool and moist and as well fed as possible. Indeed Specialty coffee is as much to do with the roots, and of course the soil, as well as the leaves. Someday, a coffee engineer is going to invent a vertical disk plough which can be used to slice through the soil just out beyond the drip line of the coffee trees and 'wrench', that is cut off any competing roots from shade trees and soil cover, to allow the coffee roots to maximise their full potential.

There are many decisions to be made not only on the type of trees to be planted, but also on the specifics of climate, rainfall, altitude, soil type relating to each area. These trees should generally be 'Dry Forest' deciduous types. Nevertheless, aggressive exotic species like Casuarina, which are pretty drought tolerant and are also bird friendly should be also seriously examined. Casuarina originates from the Pacific[29], but in Vietnam, along the coast, it is very popular for seed eating birds. Casuarina species are to be found right around the Central American States and the Caribbean. It is these tall nitrogen fixing trees, pruned to give long straight stems with tiny branches, that will provide the future hardwood building timber supplies for the population.[30] (Q.V. extra paper on pruning shade trees.)

It is also possible to quickly change over from full sun coffee to shaded coffee by growing tall bananas as the shade, at a much closer spacing. Q.V Additional Notes. Generally, the choice revolves around nitrogen fixing species of trees which can be heavily pruned each year and which produce loads of small soft foliage to be used as mulch around the roots of the cash crop growing in the alleys. Continually pruned like a hedge, or as a line of furry beanpoles, even old trees can still produce masses of soft quick rotting foliage. Once Casuarina grows above pruning height, around 6 metres with the right tools, their soft filmy foliage provides an excellent general light shade cover.

Don't forget the Birds and Bees:

In between the tall alley trees and over the top of the rows of coffee the next requirement is for wide spreading deciduous 'second story' trees, like Inga, Gliricidia, Erythrina or Leucaena species, which can protect the coffee and the soil during the heavy rains but then drop their leaves near the end of the dry season, when the coffee berries are getting ready to swell and need lots of sunshine and photosynthesis for filling their beans with proteins, carbohydrates and oils, the prerequisites for good quality coffee. However, once again there are many choices here for species with edible fruits, flowers and related insect life for the birds. There should also be a number of different species chosen to provide the kind of variety that might be found in a natural forest but more useful than what might have been there before. Do remember that 'dry forest' does not have a lot of epiphytes and moisture retaining growth up in the tree tops, and so insect life is limited. Here is when local knowledge comes to the fore, and over the general consensus of the discussion groups, each individual can still put together his own unique combination to feed his family, supply them with honey, and sell his coffee as 'organic' 'shaded' 'bird friendly' and any other superlative that will gain him a premium price for his product. The World market is flooded with mediocre coffee, and this has to be 'better' coffee to earn better prices than before. As well as a tree climber, there is always one person in the community with a reputation for not being scared of

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28 http://www.ctahr.hawaii.edu/nelsons/Hawaii_Coffee_Quarterly_Issue4.pdf

29 http://en.wikipedia.org/wiki/Casuarina

30 http://www.springerlink.com/content/m27657728601k803/

'Africanised' bees, usually by working them at night! . And that is the person to get sent off to a special course on DIY honey production with 'top bar' hives[31].[32] Honey is a very swoppable tradable commodity in the community.

What about the Livestock?

Leucaena, like Casuarina, has the reputation for being an aggressive species that if not kept in order will soon take over everything. However, aggressive species are what we need to extract the maximum from what typically starts out as a poor denuded soil, so that we can then prune the soft leaves and recycle those hard won nutrients back through our livestock, or our food garden or our coffee.[33] What makes these species 'aggressive', is the microbiology within the 'rhizosphere', ie. their root systems. These organisms can dredge more nutrients out of old soils than can the likes of coffee or other non leguminous species. [34]. Leucaena is not the answer to every problem, but the beauty of this tree/shrub depending on the variety, is that it is not only a legume and soil reviver, it is also a source of very fast growing firewood, and makes very good live fence posts. [35] [36] [37] Firewood is a vital necessity for peasant life!

L. collinsii appears to be the best choice for those pH 5 soils of the Trifinio, and not as toxic as the base varieties. However, supplies of lime, and better still gypsum, are available throughout the area to assist any acidity problems once cash flow builds up. [38]

Pole Cuttings:

Leucaena is not known as an easy tree to establish from small cuttings, however tall saplings or poles, cut and trimmed of all their leaves can be replanted as a line of living fence posts which, if they catch the wet season rains will take root and grow with most of their leaves up higher than a cow or goat can reach, but still low enough for a man to slash down those lush leaves for animal fodder. Initial plants introduced into the area should be inoculated with both VA Mycorrhiza and Rhizobia to enhance drought tolerance and increase biomass production.[39] The use of such 'Pole Cuttings', three metres plus long, makes for very fast establishment times of a tree that can still be grown in the presence of animals and quickly become a source of feedstuff and a shade factor for food gardens or for coffee. Food gardens and a couple of animals are just as important to a peasant family as their coffee.

Animals are very good for treading down Mucuna and spent corn plants, but not so good if they get in amongst the coffee. Nevertheless, even the worst goat used to debarking every fence post in sight can be baffled by a split hollowed out bamboo wrapped around a tree trunk.

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31 http://www.apiservices.com/articles/us/fert/nicaragua.htm

32 http://blog.sustainableharvest.com/?cat=42

33 http://www.mixph.com/2010/06/cattle-raising-and-fattening-business-guide.html

34 www.ag.auburn.edu/enpl/faculty/kloepper/.../88kloepper.pdf

35 http://www.fao.org/ag/AGp/agpc/doc/gallery/pictures/leuleu.htm

36 http://www.aciar.gov.au/web.nsf/att/JFRN-6BN97T/$file/pr57chapter02.pdf

37 http://www.aciar.gov.au/web.nsf/att/JFRN-6BN97U/$file/pr57chapter03.pdf

38 http://www.aciar.gov.au/web.nsf/att/JFRN-6BN97V/$file/pr57chapter04.pdf

39 http://www.springerlink.com/content/c877828787163rl7/

Quick and Easy Fencing:

If there is bamboo available in the area, or if its possible to grow ones own supply and cut it at the time of lowest sap sugar levels, then split flattened haulms of bamboo can be woven through the line of planted poles to give a very quick fence indeed with bamboo that will last for up to two years. Split bamboo with high sugar levels will be eaten out in a year, so it pays to have a bunch growing in a corner somewhere for correct harvesting practises. Sesbania species are even quicker than Leucaena and just as useful, but not as long lived. For more details see in 'Gardens' below. If there are no animals, then hedge planting becomes a choice of fruit bearing or other species that can contribute to the resources of a peasant family. One of the advantages of having a Co-operative nursery is that new exotic species of desirable fruits and nuts can be easily introduced. One of the first 'Peace Core' Volunteers to be invited in, is someone to train up 3-4 young locals as Nurserymen.

Keeping it all under Control:

Vetiver can be killed very quickly with 'Roundup', but is pretty much immune to animals. The crown of the plant occurs slightly below the soil surface so that grazing goats or even trampling cattle cannot do lasting damage. Moreover, the mature foliage is so tough and coarse that even with all the cattle roaming the countryside in India for example, the plant is never destroyed. This is important for an erosion control crop that, if it is to work effectively, must stay in place for years, even in the presence of hungry animals. Do be aware however, that those tough grass stems that don't mulch down as quickly as soft green foliage from trees, nevertheless contain lots of basic nutrients sucked out of the bedrock from meters down below. Of particular note is its ability to accumulate phosphate and encorporate that into the biomass.[40] And if the plant nursery has done its stuff, they will also be innoculated with all the newly discovered varieties of nitrogen fixing bacteria.[41] [42]

On the other hand, if the vetiver plants are cut back during the growing season, then the masses of new soft green shoots that quickly arise can be fed to livestock as a quick response to hurricane damage etc. If the family goats can be kept milking, then the children can still be fed.[43] And if the animals are penned at night, then the dung can go on the vege garden . It only takes one old Billy in the district, owned by the Co-op of course, and kept in a special pen, to play host as required to a goodly flock of nannies from all around the area, and keep them all breeding and milking. It is a single well bred Billy, able to be afforded by the Co-op, that ups the quality and breeding of the whole district.

Growing food for the family:

Enhancement of food and produce gardens can also be encouraged by means of "Alternate" alley cropping .principles. Denuded tropical soils tend to be well leached and to have little of the 'cation exchange capacity', necessary to retain fertilizer molecules on the surfaces of mineral soil particles. Therefore the levels of organic matter must be rebuilt, at depth as well as on the surface, in order to retain plant nutrients as organic matter and make them available to new plant roots. The easiest way to do this is to alternate rows of Leucaena poles on a two yearly basis

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40 www.agnet.org/activities/sw/2006/.../paper-590166297.pdf

41 http://www.ncbi.nlm.nih.gov/pubmed/9924818

42 www.plantphysiol.org/cgi/content/full/127/2/390

43 http://books.nap.edu/openbook.php?record_id=2077&page=9

with ones food crops. Micro-alley 'Root tracing', where new roots follow down the channels of old rotten roots.[44] Many experts decry alley cropping because the lines of food next to the alley trees always suffer, particularly if an aggressive species like Leucaena is used. However, a little understanding can easily mitigate this sort of problem.[45] Keep the rows of Leucaena well trimmed back, to let in as much sun as possible and provide mulch for round the veges! If it does look as if the vegetable line next to the tree line is suffering, then wrenching, to the full depth of a spade up the line, or that disk plow owned by the Co-op, will cut off the leucaena roots and as they die they will provide extra nutrients for the vegetable line. As will be reiterated below, Quezungual provides mulch on top of the soil, but the real value of old fashioned slash and burn 'swidden' is what it produces as rotten roots under the soil. Ash fertility is gone after the first couple of showers of rain, but 'roots rot on'! So, lets slash and mulch but also slash some species like Leucaena at ground level or below, and 'kill' off those particular plants for their under the ground value as well.

Leucaena is for Everything:

2 months before each growing season, cut off the roots from a row of two year old Leucaena stems, as far below the ground level as possible using a narrow 'drainage' spade to wrench around each stem before pulling it out. Save the stems and stumps as firewood , posts, or fast growing shelter trees and spread the leaves and surface rubbish as mulch. Once the roots are dead, plant ones food crop through the mulch and right along that same row, and keep ripping off any regrowth on the leucaena remnants to kill off the roots as quickly as possible. Then all the nitrogen nodules on the dying roots, plus the P and Ca dredged out by the Mycorrhiza on those same roots, will become available as plant food to the growing crops before it is all leached away by heavy wet season rains, and the P is locked up back again in the acid soil. The following year the next row of Leucaena is cut down, the smaller poles are replanted back where the veges were, and the vegetables planted on the new row after a short period. Plant those poles in deep holes, augured by rotating a steel bar in the ground so that the roots sprouting out from the end of the new pole are at least 250mm deep. This will minimise on the aggressive root interactions mentioned above. Do also drop in a handful of well 'innoculated' topsoil to infect the roots at depth with all the right microbiology. This keeps the Leucaena roots underneath that of the food crop, and acting as a sieve to catch any nutrients that may fall through. If a two year cycle is not enough to sufficiently regenerate a badly denuded soil, then alternate one year of veges with three years of Leucaena re-growth before killing it off and making its accumulated soil and root nutrients rapidly available. This method is an up date on the traditional Swidden and Milpa, or 'Slash and Burn' agriculture and, blended with the principles of 'Alley Cropping', its better even than 'Quezungual' methods! [46] In brief, 'Slash and Burn' operates on decaying root systems and 'Slash and Mulch" operates on decaying surface leaves. So, it takes a bit of both to really add another step to the development process.

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44 http://www.rirdc.gov.au/reports/AFT/02-024.pdf

45 http://journals.cambridge.org/action/displayAbstract;jsessionid=A2BED89EDFB99A610C7BFAD3AE1198E1.tomcat1?fromPage=online&aid=1616596

46 http://www.metafro.be/leisa/2002/183-10-11.pdf/base_view

Don't Slash and Burn! Slash and Kill:

The lack of fire does create problems in weed control, there is no reduction of acidity by means of the wood ashes, and there is no addition of cation exchange enhanced 'soil carbon' or "Terra preta" activity. However, it does allow the faster build up of soil organic matter and a much shorter rotation in a smaller area of 'kitchen garden' , which, because of its permanency and continuous use, is now worth the while for using some lime and some permanent fencing. After about 3-4 rotations the buildup of soil organic matter and earthworms etc. is such that the soil will be richer and more fertile than any of the old men can ever remember! This is largely due to the way that mycorrhizal enhanced root systems can extract more minerals from denuded soils and hold it ready for easy use, than can the food plant roots alone. [47]

Don't Waste Charcoal:

Despite the lack of biomass burning, the whole business of 'Terra preta' [48], 'Bio-char' and application of fine charcoal to leached and heavily denuded tropical soils has much to commend it, especially if it can be achieved within a smaller permanent garden situation.[49] Black soil carbon is something that even the poorest Peasant can make for himself at no cash outlay. And what it does is to provide cation exchange to latch onto fertiliser molecules and greatly extend the effectiveness of whatever small additions of mineral fertilizer the Farmer can afford. All of these above activities can all be categorized under the general heading of LIESA , Low External Input Sustainable Agriculture. (Q.V. www.metafro.be [as above])

Cooking with Coffee:

It is also possible to burn coffee hulls in the new TLUD cooking stoves being developed in the Phillipines by Alexis Belonio.[50] Using rice hulls the cooking is done on smokeless gas and the ash is discharged as Terra preta style carbon char.[51] The same can be done with coffee hulls. but with a lot less carbon and ash. However, that all depends on how the coffee is sold, and especially where it is hulled.

Security is the Bane of Ultimate Coffee Quality:

The old problems of security on the road usually mean that parchment is sold wet, and the hulls are then used to dry the next batch of coffee at the merchants central factory! It will be another major step forward when the closely knit village life can adequately protect their own co-operative factory and then fully dry their own coffee. . It is a crying shame the way that commercial traders run their driers at 80oC and more, just to get it through their hands as quickly as possible. Cooked at anything above 50oC, coffee beans will extrude oil, just like roasted peanuts. Coffee beans

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47 http://md1.csa.com/partners/viewrecord.php?requester=gs&collection=ENV&recid=2119572&q=Mycorrhizal++Leucaena+Rhizobia+&uid=790704065&setcookie=yes

48 http://www.wisegeek.com/what-is-terra-preta.htm

49 http://www.css.cornell.edu/faculty/lehmann/publ/Lehmann%20et%20al.,%202006%20Bio-char%20soil%20management.pdf

50 http://stoves.bioenergylists.org/taxonomy/term/761

51 http://stoves.bioenergylists.org/en/taxonomy/term/266/9

that have a warm and greasy feel to them and look beautifully translucent because of the oil on their surface, will prematurely age and be covered in a white crust of fungal growth and become well and truly bleached in a matter of weeks.

The Ultimate Setup for Sustainable Coffee Production:

With terraces for soil and water retention, top story trees for wind shelter, moisture retention and orientated shade, second story trees for minimising rain damage, more general shade and fruit, plus all those pre-existing trees and fences that cannot be taken out until there is a suitable substitute in place to keep the farmer and his family satisfied during the change over, it all sounds really hard, but it is not an impossible task. It is generally possible to plant ones original contours around what trees still exist, and the first and second story trees can follow their own orientation and grow over the tops of the terraces. Do get the 'Certification Authorities' in asap so that they can count the number of different species there are before numbers of non utilisable species are later reduced. Some Authorities want to see 10-12 different species of trees on a plot before they will certify it. Five or six species is usually good enough for the owner, his family and his coffee. "But Rules is Rules!"

Do not plant those original contour lines of Vetiver too far apart. Then the terraces may be too high to straddle with wide spreading shade. Between half and one metre depth on each terrace is about right . Very steep slopes, given time, can be held by Vetiver walls up to two metres high! But thats a 20-30 year effort.[52] However those grass walls are not wasted ground! The Vetiver has to be regularly slashed, and will provide masses of mulch grass to be spread underneath the lines of coffee trees and fruit trees to keep their roots moist, cool and pumping the maximum amount of nutrients into those big bold beans that Starbucks really want to buy. The lines of coffee immediately down hill of each Vetiver terrace will gradually have their roots exposed as the soil is rearranged down behind the terrace below them again. The toe of each terrace is where the Shelter trees should be planted., to get a firm root hold in unmoved soil, and to keep extracting nutrients from as deep as possible. The coffee trees immediately above each contour line of Vetiver will gradually be buried as the good soil builds up against the rampart of grass that steadily keeps pace with it. Transplanting these trees at the same time as they are cut back for recycling, ie. taking out the disappearing old rows to create new rows aligned with the terraces does take work, but it is a slow gradual process that doesn't demand instant labour until everything has stabilized. You can't win everything. If there are deficiencies in the local soil, then some extra assistance may be called for to rectify that in ways that will not upset the 'organic' fraternity. A hand full of rock phosphate and raw limestone down the hole before the tree goes in will maximise the efficiency of bought in fertilizer. Organically approved fertilisers don't burn off roots, so they can go straight in the hole! Revitalising worn out soils from their own resources is not easy, but neither is it impossible. And once a solution has been found , that problem has been solved for ever, if it is shared around the farmers discussion groups.

Processing Coffee. Co-operative Methods:

Every country has its own traditional methods of processing coffee. However, with quality in mind, not to mention water conservation and pollution control, a small co-operative factory with enough initial capital to buy a small motorized drum pulper and a portable trash pump is the preferred option. Nowadays small factories

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52 http://permaculture.org.au/2009/1/19/vetiver-grass-a-hedge-against-erosion/

can be made with upright plastic tanks and with a 50mm trash pump. Q.V. separate Paper.! They are completely portable. They can be moved from one side of the district to the other and stored away in the off season.

A Co-operative enterprise can be helped along the way by public agencies,[53] whereas private individuals usually cannot. Some Agencies from coffee buying countries are ready to assist in the actual organising itself.[54] Special tools, like those narrow drainage spades, can be held initially by the Co-op. Further down line would be a small side delivery rotary lawnmower, or a high wheel trimmer,[55] which can slash down an Arachis pintoi weedmat and side row the mulch under the coffee trees. Then in the coffee season it can be retro fitted as a 'Mower Blower' to blow hot air for back up coffee drying purposes.

Avoiding disaster:

When ones land does not require terracing, or when terraces are well established the best form of weed control is to grow a low ground cover plant like Arachis pintoi which can be slashed back to provide more mulch. However, just growing Arachis, ie. perennial peanut alongside ones coffee is a recipe for disaster. Arachis, like Casuarina and Leucaena is an aggressive plant with very active roots which can suck far more nutrients out of a poor denuded soil than coffee roots ever could. Grow Arachis around coffee trees, and the coffee will will lose the race and get starved, to death! But all of these aggressive plants then need to be made to share their takings back with the crops in question, by being slashed back hard, very hard, and their soft high protein biomass used as mulch and composted back underneath the crops that they have stolen it from.. Trees are not altruistic! They will not give anything up by themselves! When a tree drops its leaves by itself, it is only the dead framework of cellulose that is left. They have clawed back everything nutritious that they can get before they let their leaves go! Even in the tropics, natural leaf fall is of little fertiliser value. The farmer has to be aggressive too and take off soft nutritious leaves to transfer protein and nitrogen back to where it is needed, under the drip line of their coffee trees. However, do spread some drier mulch up close to the stem. This becomes a haven for bronze beetles and other predators and makes harder work for those ants that will farm the greenscale on ones coffee if they are allowed. Predatory beetles are virtually the only answer to stop Cicada grubs which will eat enough roots to kill stressed out coffee. Dry forest country is not usually humid enough to allow Verticillium lecani to spread and breed. This fungus is unique in that it will attack Greenscale, an animal, and Leaf rust, another vegetative fungus.[56] [57] How ever, it is well worth the trouble for that local plant nursery to have a small supply available.

Low Cost Communal Processing:.

All these factors can be catered for, and all the factory wastes as well as the mulch recycled back onto the coffee. With coffee processing being in the wet

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53 http://en.centralamericadata.com/en/search?q=Cooperatives&q1=content_en_le%3A%22Agronomy%22&q2=content_en_le%3A%22coffee%22

54 http://www.globalexchange.org/campaigns/fairtrade/coffee/cooperatives.html

55 http://www.nextag.com/high-wheel-trimmers/search-html

56 http://onlinelibrary.wiley.com/doi/10.1111/j.1439-0418.1978.tb01923.x/abstract

57 http://aciar.gov.au/project/ASEM/2004/047

season, sun drying on fold up rolls of plastic sheeting rather than concrete patios once again is the low cost option.[58]. A whole field of coffee on foldup/wrapup lines of plastic film can be protected from water a lot quicker than raking up coffee on a concrete barbeque slab.

Small farmer Groups in East Africa have been organized by the Specialty Coffee People, Technoserve, the Quality Coffee Institute etc. with factories that use upright plastic water tanks instead of in situ concrete tanks that are a permanent fixture. (Q.V. separate document) This means that everything can be bought, first or second hand, moved, mortgaged and sold. It also means that the local agricultural banks are a lot happier to lend money on something that they can recover and sell if required. That makes financing a whole lot easier.

However , the purpose of this short paper is not to go into great detail, but just to outline general concepts of how Coffee can be the focal point for Regeneration and Development. The size of each family's holding; the relative steepness of the land; whether it is old cattle grazing grassland; or Quezungual, or Swidden country; the present degree of erosion; and local rainfall are all special points which have not been individually addressed. Maybe it is an enlightened large landowner wanting to regenerate his old cattle ranch? Further details on each of the points mentioned are to be found in the supporting literature and references.

> This document is still only in draft format. Comments and Criticisms are most welcome. It has been written in response to the masses of literature on these topics that has been written by academics who have obviously never tried to grow coffee! The Author is also preparing a detailed order of development procedure, available on request.
>
> Write to Ken Calvert. renertech@xtra.co.nz

Additional Notes:

Using Bananas as Shade.

Any decision to change over a block of full sun coffee to make sustainably harvested shade coffee cannot be done in a hurry. You cannot stop using chemical fertilisers without first cutting back on the photosynthesis by growing shade and also boosting the roots by keeping them cool, moist and mulched. If you do just stop using fertiliser, then overbearing die back will take its toll! The quickest way to get shade is to follow the common trend of growing tall bananas along with the coffee, using them as both primary and secondary shade whilst the terraces and the tall primary shade are growing. Typically these are planted in a haphazard manner and tend to grow in clumps. The major difficulty is getting enough planting material to expand the operation.[59] One stem will usually naturally produce only 3-5 suckers, whereas hundreds of tree seeds can be sown and propagated in quite a small nursery area. High altitude bananas will never compete commercially in price and quality with the 'Big Three' and their massive plantations on the flat lowlands. They have to develop their own local economy. There is a multitude of banana based stick candies and chips, fried in oil, baked or dried.[60] [61] Bananas do not make a high class

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58 http://www.acss.ws/Upload/XML/Research/335.pdf

[59] http://www.scribd.com/doc/28850708/Micro-Propagation-of- . . Bananahttp://www.scribd.com/doc/28850708/Micro-Propagation-of-Banana

[60] http://www.bananafruits.com/banana-products.html

wine, always a bit too much Amyl acetate in the flavour for the Gourmands, but it is an excellent way of making a permanent product out of a highly perishable commodity[62]. neverheless it also can brighten up a dreary existence for a cash strapped community. And banana fed pork to go with it? Christmas!

Once a decision is made to start terracing with Vetiver it is usual to grow coffee in rows parallel to the terraces, to allow for future ease of movement and mechanisation, and this means propagating the bananas in the same way. Three rows of coffee with a line of Bananas between each row, ie 7 rows overall, is usually about right for a 10-12meter wide terrace. Planting each banana stem 2 meters apart in the row and taking out all the suckers except those in line with the existing row will keep the plants in line, with each generation of new stems slowly walking down the same row. The tall trees for wind are just as necessary, if not more so, for the bananas as well as the coffee, plus the usual bunch of bamboo in the back yard for banana props along with the fencing slats. Recent research indicates that Nematodes maybe held in check by a soil rich in VAM,[63] vesicular arbuscular mychorhiza , already part of our microbiological soil amendments.[64] Innoculating the soil with Trichoderma harzium another predatory fungus and soil improver [65] [66] will also control nematodes, but this is best done through that all important local co-operative plant nursery. Bananas don't do any better than Coffee when planted with Arachis pintoi.[67] So, keep that slasher handy!.

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61 http://www.fao.org/docrep/x5045e/x5045E08.htm

62 http://www.pinoy-negosyo.com/2006/09/making-banana-wine.html

63 http://eco.confex.com/eco/2008/techprogram/P12121.HTM

64 *www.beeflambnz.com/download_file.cfm/RD_Brief_89.pdf?id=223,f*

65 www.freepatentsonline.com/6475772.html

66 http://www.actahort.org/members/showpdf?booknrarnr=698_30

67http://www.publish.csiro.au/paper/EA9941197.htm