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# **PERMACULTURE: DISCOVERING NATURE, DESIGNING ECOLOGIES.**

Elaine Forde

## **INTRODUCTION**

Whereas this volume explores the material culture of food, or “food stuffs”, in order to extend existing dialogues about the materiality of food itself, this chapter seeks to approach foodstuffs at a more elemental level by examining the materiality of agricultural systems, treating food and non-food plants themselves as material objects. In order to do this, this chapter explores permaculture, a fairly new approach to agricultural production in which the “intra-action” (Barad 2003) between food and non-food plants is taken as the key factor in successful growing. Based on ethnographic research conducted at eco-villages in West Wales, this chapter shows how permaculture's methodology transcends positivism, focussing instead on the relationality of substances in order to craft radical, more than human (Whatmore 2002) ecologies. It may be argued in that case, that permaculture represents a transformation in both the social and material practices that comprise agricultural production, yet a more promising analysis using the new materialist literatures will focus on the material agencies that the permaculture approach to food production is concerned with. This chapter argues that the permacultural focus on material agency in the context of agricultural production directly addresses the relationship between the material details of everyday life, and broader geopolitical and socioeconomic structures (Coole and Frost 2010). As such, it is argued that the new materialism can inform an anthropological understanding of permaculture practice as a sustainable and materially-engaged foodway.

## **THEORISING PERMACULTURE**

There are many interpretations of permaculture, but generally it means either “permanent agriculture” or “permanent culture”, and is organised around the three core principles of earthcare, peoplecare and fairshare (Lockyer and Veteto 2013, 12). Permaculture is a practical expression of environmentalism that provides a set of skills and technologies to create a sustainable future for humans to live as part of nature, by incorporating a set of values and an approach to living, organising space and everyday life.

Permaculture is practiced widely but has found a particular niche amongst small-scale

agriculturalists and horticulturalists, environmentalists and activists. The term permaculture was originally coined by two Australian bio-agronomists (Mollison & Holmgren, 1978) who began experimenting with polycropping systems to develop a framework which could work for landscapes of any scale. Originally consisting of landscaping ideas, such as digging out swales to retain water and encourage biodiversity, the permaculture framework has gradually extended into a set of ethics based on the three principles of *Eartchcare*, *Peoplecare* and *Fair Share*. Permaculture now represents, for some of its practitioners, a design approach to all aspects of life.

The initial development of permaculture must be viewed as a response to Australian conventional agriculture's increasing reliance on unsustainable systems, and it is grounded in ecology, systems ecology, landscape geography and ethnobiology (Veteto & Lockyer 2013, 101), however it has not been readily embraced by academia due to its wide-ranging interdisciplinarity, and mismatched approach to the prevailing social, political and economic context (Veteto & Lockyer 2013, 98). Permaculture also remains a marginal ideology in the mainstream, a discrepancy brought about both by its antithetical position *vis a vis* subsidised industrial agriculture, and its relative vagueness: Pickerill (2013, 181) notes astutely that permaculture is a principle, rather than a set of rules, and that as such there is no precise shared interpretation of what permaculture is. Permaculture's cross disciplinarity, lack of specificity and wide-ranging application has meant that it has resisted academic scrutiny, and while permaculture has developed practice, it has not responded to many theoretical developments in the fields which it touches.

Veteto and Lockyer's 2013 edited volume represents one of the first sustained anthropological examinations of permaculture, with seven independently authored chapters that collectively call for a greater dialogue between environmental anthropology and permaculture. The chapters explore permaculture using diverse theoretical approaches, from thinkers such as Ingold or Latour, who both argue for a monist approach to "natureculture" (Aistara 2013), to a Bourdieusian analysis of the spatial ordering of an urban permacultural sprawl, which it is argued has created a permacultural habitus in Toronto (Haluza-DeLay & Berezan 2013). Elsewhere (Forde 2015), I have argued that permaculture is a not unproblematic, morally-imbued activist politics but here, inspired by the possibilities that the new materialism can offer, I approach permaculture at a more basic level, at the level of material interaction. Such an approach seems wholly appropriate for a topic like permaculture. As a framework there are relatively few rules applicable to every context, but the tenets of the practice can be reduced to a process of empirically observing how plants (and other material objects including non-human animals) intra-act, without interference from humans.

The key position of the new materialism is that the assumption that matter is simply inanimate is wrong. Matter is “vibrant”, according to Jane Bennet (2010), and the long held idea that matter is inanimate forms a serious impediment to the emergence of materially sustainable modes of provisioning. If matter is not inanimate then it has a certain agency, and even within the new materialism there is a divergence in how that material agency is conceptualised. Whereas for Bennet, agency is intrinsic to things, for Karen Barad (1998), who has developed a theory of agential realism, it is the intra-action between what she calls “phenomena” (phenomena are the most basic unit of matter, akin to atoms) which is the point at which agency manifests (ibid: 96). In Barad’s view, what she calls a performative metaphysics, matter and materials are only knowable through the intra-action between different phenomena (Barad 2003, 808). In other words, agency for Barad is encountered at the point of intra-action, rather than being intrinsic to all materials, as per Bennet. In Barad’s approach, material agency is not waiting to be discovered, it simply manifests as it is performed. Agential realism has implications for social science more generally. As one of a host of critical realisms (Bhaskar 1997; Maxwell 2012, 4) agential realism also interrogates a crucial divide between representationalist modes of inquiry and realist approaches.

Permaculture’s concern to decentre human agency, by observing natural agency and designing around it, is not unproblematic in its belief in an inherent balance of nature – an approach which the new ecology has resoundingly rejected (Scoones 1994) – however, the promise of a new materialist approach, coupled with a realist approach to research can compensate for discrepancies that arise from taking a representationalist approach to the question of “nature”. Coole and Frost for example, argue that the new materialism addresses complex issues such as climate change, GM food and ecological resistance that the more dominant representative discourses associated with postmodernism have been struggling to deal with (Coole & Frost 2010, 6). This chapter therefore takes the idea of material agency as an entry point into an examination of how a permacultural framework is put into practice to create sustainable and materially-engaged foodway, focussing less on how to represent permaculture, and rather more on what it entails. The chapter moves to a description of the methodology employed, introducing the key field sites and sources. This is followed by a discussion of how permaculture operated in West Wales ecovillages, what the general approach was and what practices were encountered. Permaculture practice is analysed in that context with recourse to broader literatures about agrarian history and politics. Finally, the chapter explores the possibilities that the new materialism has for understanding permaculture practice, and where this approach may enhance existing political-economic and structuralist critiques.

## PERMACULTURE IN THE FIELD

The material presented in this chapter derives from permaculture practices observed during the course of ethnographic fieldwork conducted at ecovillages in West Wales (Fig. 8.1) in two separate phases. Initially for a consolidated period of around eighteen months between 2010 and 2011, and in chunks of time and sporadic visits to people and places involved with permaculture in the west Wales region after that.

<FIG. 8.1 here>

### Fieldwork

Not every research participant of the initial study engaged with permaculture so the material presented here comes from research in one particular ecovillage, called Tir Y Gafel. This ecovillage is located in Pembrokeshire, close to the Ceredigion border. The site is nominally owned by an Industrial and Provident Society (a ‘co-op’) called Lammas, which is concerned to promote and enable the building of ecohamlets through advocacy, and the promotion of Tir y Gafel as an exemplary site. Tir y Gafel describes itself as an “ecohamlet”, not a communal group. The land is divided into nine separate plots that are leased to residents on 1,000 year leases that are inheritable, and which give clearly defined boundaries for each plot. Five plots of five acres are fairly large compared to the other four plots, which have around one acre each and are grouped closely together; the four smaller plot-holders also share almost 20 acres of hay meadow. There are also shared areas at Tir y Gafel which are not part of individual plots. This includes shared woodland and areas such as the millpond, the village hall called *the hub/ yr hwb* and hedgerows. Residents contribute personally to the maintenance of shared areas, plus they have to pay Lammas for the infrastructure—road building, plumbing and power distribution. Power is supplied to the ecohamlet by a hydro-electric system set up on a river that flows through the land.

Group consensus about how to live at Tir y Gafel is mediated by Lammas’ mission to promote low-impact development, and as such, residents must respect the low impact ethos. Additionally, Tir y Gafel is clearly described as a “permaculture project” (Lammas, 2012) by the group’s website and associated literature, including aspects of the planning application for developing the site:

“The [group] has chosen to use permaculture as a way of designing their project, not only to reduce the impact of their living, but also to provide a model for how to live sustainably in harmony with the resources of the earth. The intention is to inspire many others and help broadcast the ideas of sustainability, low-impact living and permaculture far and wide. The example set by [the group], in its entirety, will help the local council meet their objectives and demonstrate how other councils can do the same.”

(Macnamara, nd)

Because of this explicit commitment to permaculture, this chapter mainly draws on ethnographic material from residents, volunteers and visitors to Tir y Gafel to examine permaculture’s methodology and practice.

## **Research**

Researching permaculture is not straightforward. Since it is a framework and not a formula it remains an elusive practice, tailored to each bio-regional context. One issue which is symptomatic of permaculture’s elusiveness is that there can be many poor examples of permacultural work, as well as clear and inspirational successes. In research terms it has been useful to extend the permaculture space beyond the purely agro/ horti-cultural. As a result, some of the examples presented here discuss practices that are only obliquely related to foodstuffs, such as the idea of “waste”. Sometimes permaculture was an implicit principle in everyday practice, discoverable only through observing the use of methods which are derived from or feature in permaculture, such as the planting of a reed bed system with bog plants to process *grey water* (“post-first use” water (Harkness 2009, 286), a common way to describe household water, such as bath water, that has already been used but is not necessarily contaminated). Revealing the use of permaculture therefore required a certain amount of knowledge about what permaculture was to begin with, as well as the ability to tell what was specifically permacultural, and what was common gardening practice anyway, or part of a growing repertoire of green activism and politics. My work on a shared vegetable and fruit garden at one of the ecovillages, though not specifically permacultural, was a good grounding in investigating permaculture further.

In addition to this ethnographic work, permaculture has a strong textual and discursive presence in websites, publications and magazines, for example. I have also used activist pamphlets and publications, not all of which are necessarily pro-permaculture. Many permacultural projects have

been documented by films, and I have drawn on a range of these secondary sources during my research.

It is worth stating clearly that not every ecovillage that I worked with was particularly interested in permaculture. Many of those with an intimate knowledge of what permaculture was about, remained unconvinced. Citing the odious marketing of costly permaculture courses and workshops within the ecovillage circuit and in the numerous permaculture catalogues, many committed small-scale horticulturists also felt that permaculture was not in fact necessary. In addition, it became clear that many practices that were nominally called permaculture by some ecovillagers were simply part of the regular horticulture practiced by others not under the permaculture rubric. Many of what are considered permacultural techniques have clearly been synthesised from other agricultural or horticultural systems, polycropping is a particularly clear example of this. However, this sort of synthesising tends to be celebrated rather than obscured.

## PERMACULTURE PRACTICE IN WELSH ECOVILLAGES

This section explores three examples of permacultural practice using ethnographic research data.

### **1. Waste: Reassessing the Properties of Materials**

To be sustainable, permaculture techniques are aimed at reducing effort and expense, nothing goes to waste. Instead, “waste” is a useful source of fertility or resources. In a practical sense, permaculture rationalises the use of materials, labour or time. The sort of *techne* typical of (but not exclusive to) permaculture embraces any materials with potential use. In terms of refuse reuse, permaculture gardeners might hang old CDs around the garden, where the reflective surfaces can deter pests such as birds, cats and deer. One might save yogurt pots to germinate seeds in or to cut into strips to make plant labels. Another technique is to paint old food tins black and place them around carrots to protect them from carrot fly. Every sort of organic waste matter would be composted using techniques from compost toilets to vermiculture.<sup>1</sup> In addition to such brown manure, permaculture gardeners use green manures such as rye grass or comfrey around crops and at times when garden beds might otherwise be empty. This also saves buying in soil improvers. Every form of waste water would be re-used, *grey water* would be stored for watering plants, or might drain straight into strategically-placed planters. *Grey water* could be filtered through a reed bed system where naturally occurring microorganisms clean the water. A basic reed bed system can clean waste water for a family by emulating a wetland habitat. Larger-scale reed beds with longer

filtration can clean *black water*, which is contaminated and might be riskier. In practice I did not encounter anyone who even generated any *black water*; it seemed that everyone preferred to use composting toilets.

While I met many people who embraced the reuse of materials that would otherwise be wasted, not everybody encountered in the field approved of all materials, in particular their respective aesthetic effect. Graham, a resident of an ecovillage, which did not take permaculture as an organising principle, was a keen gardener, but baulked at the aesthetics of permaculture:

“Permaculture? Hmm. No. I’m not sure about *that*. It seems to me like a lot of rubbish strewn all around the garden, margarine tubs, old motor tyres and *black plastic*. No.” (original emphasis)

Though they cannot be considered to be permaculture as such, Earthships, a type of passive solar house made from low-carbon/ low-impact and recycled materials, are an example of a green architecture that makes liberal use of “waste” materials. Rachel Harkness (2009) describes how Earthship dwellings are made from the same earth that is excavated from the dwelling-site, as well as incorporating post-consumer waste. In particular, car tyres are rammed with earth to create building blocks with incredible thermal mass, and old drinks cans, glass or plastic bottles “in-fill” non load-bearing walls with plenty of insulating space before the structure is plastered with earth plaster from the site (ibid: 31). Though none of my research participants were building Earthships as such (the design and reliance on earth plasters was generally not thought suitable for the Welsh climate), the reuse of waste materials was common practice and certainly fits within the extended space of permacultural thought.

## **2. Working with Materials**

I met Jack whilst I was staying at Tir y Gafel. At that time, Jack was hoping to buy a plot of land near to the ecohamlet, and meanwhile was visiting the site and doing some work around the village green and hub garden. I had located myself near to the hub building for my stay and so I saw Jack on a regular basis. I noticed that in particular, Jack was spending a lot of time working on what looked like an ornamental flowerbed. I asked Jack for a few moments to find out more about what he was doing. It was at this point that I noticed he had brought a copper tool that looked like a small mattock to work the soil with. I was surprised. My own experience of doing heavy gardening work



with hand tools meant that I imagined that a copper mattock would be far too soft to work the ground. I wanted to know more:

EF—Is that copper?! Isn't it a bit.... you know, soft?

J—Well of course, you wouldn't break new ground with it! No, I've put a lot of work in already so I know there aren't going to be any big stones.

EF—But why copper? Surely it's really expensive and you have to be so careful?

J—Yes, you do have to be careful with it... Copper's great because it doesn't interfere with the electromagnetism in the earth: steel or iron based tools just disrupt the natural flow of energies, but copper doesn't. You see, you need to connect the plants with the networks of minerals and elements that just flow through the soil already, you don't want to break those structures if you can help it.

At a later point I explored some of the permacultural literature around copper tools that did indeed corroborate what Jack had described. In addition, using copper, or at least bronze tools in preference to iron or steel was said to deter slugs somewhat (Harland, n.d.). Again, the relationship between slugs and either iron or copper-based tools, was framed in terms of material intra-action. Slugs, as creatures without iron in their blood, were sensitive to even the small iron deposits in the soil that are left by iron-based tools under routine use, slugs are therefore attracted to sites which had recently been worked by iron tools (Harland nd). Reviewing the permacultural literature on copper tools there is no immediate consensus on why copper might be a better material than iron, however the varied explanations offer ideas about copper's material intra-action with the soil and the plants and beasts in it, and how that differs from iron-based tools. For example, Cobbald (nd) suggests that rusty iron tools invite decay into an otherwise vital soil, whereas Harland (nd) describes the conductive properties of copper, suggesting that these disturb soils far less. In both cases, soil is not imagined as an inert material, simply a "medium" for other processes, soil has agency and its own vitality.

### **3: Working with nature**

During a visit to the ecovillage Tir y Gafel, which held regular Open Days, resident Cathy was showing a group of us around her garden. I was looking at small garden beds which contained a mixture of plants. Some of these I recognised as kale but I did not recognise the finer, purple-flowered plants. As Cathy passed by, I asked her about them, and to my horror she started pulling

them up as if absent-mindedly destroying them while she talked:

“These? Oh, these are buckwheat.”

[Are you growing grain here?]

“Oh, no. They’re a green manure.”

I must have looked blank, so she continued:

“You just grow them alongside other plants. They harness beneficial nutrients.

When they’re flowering like this, you can just pull them up and leave them to compost around the plants like a mulch. Easy.”

It certainly did seem like an easy system, as Cathy was essentially able to feed her plants and condition the soil by simply strolling past the bed, pulling up a few flowers and dropping them *in situ*. Cathy’s views on this system were expressed in terms like “easy”, and she described the plants as doing the work that otherwise she might have to do to keep her crop (kale) healthy (e.g. harnessing beneficial nutrients). Cathy’s main interest was in the relationship between the two plants, and on how they intra-acted with each other, while the extent of Cathy’s involvement in this system was minimal. It was possible even to allow the buckwheat to self-seed, thereby creating a permanent system. Such systems could be regarded as a hallmark of permacultural practice. Companion planting such as this is approached by first establishing a knowledge of a plant’s properties within its environment, and how these properties will affect or be affected by other plants. Permaculturists are not so concerned with what the plant will give them, (e.g. a crop or a yield), but what work it will do in the garden. In other words, permacultural companion planting is premised on the agency of the plants themselves, and what their combined agencies will effect.

## NEW WAYS TO THEORISE PERMACULTURE.

### **a. Permaculture and the New Materialism**

The examples discussed in the previous section were presented in order to give an overview of the sorts of permaculture techniques that were commonly used in the research field. As noted above, though, because permaculture is more accurately described as a framework, the exact components of permacultural practice are context dependent. This means that an examination of permaculture practice in another context would contain very different ethnographic material. In spite of this plurality, it is possible to make generalisations. What does seem to be common in all permaculture contexts is the approach that permaculturists take to the material world, and I suggest that this approach can be broken down to a process of observing material intra-action. Barad notes that

“If we follow disciplinary habits of tracing disciplinary-defined causes through to the corresponding disciplinary- defined effects, we will miss all the crucial intra-actions among these forces that fly in the face of any specific set of disciplinary concerns”. (Barad 2003, 810)

With this in mind, permaculture practically demands to be analysed using the new materialism literatures, how else to approach a multi-disciplinary topic that has so far resisted much engagement with theory? The fit between the topic and the literatures I propose is evident in the three examples discussed above.

I examined some of the standard and more inventive ways that waste could be re-used in a permacultural system. Using the new materialist literature lends an important insight to the question of “waste”. Reno (2009) uses a largely political-economic approach to examine the politics of value at a landfill site. Reno argues that there is a subtle interaction between scavenging and dumping practices that is creating a new regime of waste-value. This process is certainly at play in a permacultural system and by extension other similar waste-deploying techniques that form part of the environmentalist movement. Though not precisely permacultural, I cited the example of Earthship architecture to illustrate that the question of reusing waste products does not create new value out of the fact of something being waste, rather the material properties of the object in question are what is at stake. If a rammed-earth tyre creates an impressive amount of thermal mass, then the tyre has found a new utility based on its materiality, the material properties of rubber and earth which are inherent in a rammed earth tyre, and not necessarily based on its status as “waste”. Similarly, permaculturists may not try to remove large rocks from a growing landscape if they offer a beneficial thermal mass. For some research participants, notably those that did not practice permaculture however, a material’s former status as “rubbish” meant it would never be acceptable for reuse in a garden.

The second example illustrates how in permaculture all matter is thought to have agencies that are performed by intra-action with other matter. This idea is at the core of permacultural practice, as well as central to Barad’s agential realism. The idea that iron-based tools leave a deposit in the soil that might negatively affect the soil’s existing conductivity is reminiscent of what Bennett (2010, after Deleuze & Guattari, 1987) calls the “vagabond” quality of materiality. Citing the example of digesting food, Bennet shows how the process of eating and digestion reduce a carrot to forms of matter that are unrecognisable as a “carrot”, but which instead reveal, “a vitality obscured by our

conceptual habit of dividing the world into inorganic matter and organic life” (Bennett 2010, 49).

I also examined polycropping systems in order to illustrate how companion planting works in permaculture. In this example, Cathy was not directly using the buckwheat as her own crop, she had planted the buckwheat for the kale so that the two plants would intra-act. The buckwheat drew nitrogen from the subsoil to feed the kale as it later decomposed. It is possible, of course, to argue that Cathy indirectly benefitted by having the buckwheat perform labour on her behalf, however that risks creating a circular argument that has been much explored in the anthropological literature on gift exchange (eg. Parry 1986). Indeed, in the context of exchange, which might be extended to this example, Parry concludes that it is always possible, however tedious, to multiply examples which would “show a tendency to see exchange as a dyadic process occurring between two self-interested individuals” (ibid: 454-455). At some point such an argument must be abandoned. The questions of labour and morality are however, intertwined in the context of agricultural production and take on a particular significance in accounts of permaculture, and so will be explored in greater detail below.

## **B. Permaculture and the Questions of Morality and Labour**

The relationship between agricultural production and labour has been couched in moral terms at least since Locke, and a range of labour theories of value all hinge on the notion of morality.

Whereas Barad (2003) uses queer theory to argue that Foucault, in queering Marx positioned the body as the site of production – an insight which has shaped the new materialism to a great extent (ibid: 809) – permacultural practice, which harnesses the labour potential of nature itself, seems to sit outside of such theories. I suggest that permaculture goes a stage further again, queering even Foucault, in shifting the site of production to the very intra-action between phenomena.

I would often hear permaculturists use the rubric “to work with nature, not against nature” as a way to describe their practice. The belief in the possibility of harnessing nature’s labour warrants a more thorough examination. There is, of course, time and labour spent in permaculture, but the majority of this labour is in devising and designing systems which will take care of themselves, like Cathy’s companion planting, and not in labouring as such. This creates a tension with more traditional labour theories of value. Poly-cropping systems, when confronted by cultural positions that see labour as conferring rights (e.g. colonialism) have often been viewed as lazy. Scott’s account of agricultural reform contrasts modernist high agriculture and its emphasis on monoculture with the

sort of polyculture usually practised in tropical climates (1998, 273-82). He notes that the west African practice of shifting cultivation struck (colonial) agricultural officials as backwards or sloppy – soil was not ploughed up, hoes or dibble sticks appeared to just “scratch the surface” – but this in fact helped to preserve the integrity of the soil, which would have been at a high risk of erosion (Scott 1998, 283). In Scott’s account, colonial agronomists interpreted such labour-saving techniques as sloth, believing that the farming systems that they encountered which involved monocropping and deep ploughing indicated a more industrious population.

Several aspects of permaculture run counter to established ideas of garden care, and especially soil management. For instance, allowing plants to self-seed indiscriminately does not fit with the producer who must practice crop rotation as a matter of soil hygiene. As Aistara points out, traditionally trained Latvian farmers called permaculture “lazy farming”, quipping that if permaculture was just farming amidst weeds, then permaculture was everywhere on their farm (Aistara 2013, 113). In terms of a perceived tension between the moralities of lazing and labouring, permaculture is not alone in being incompatible with the efficiencies of high-input agriculture.

It almost seems ironic that permaculture is so often found as part of environmentalist or activist practice, because as a radical ecology (Forde 2015), permaculture breaks in significant ways from the tradition of Western radicalism, in the way material intra-action has shifted the locus of value production. By co-opting plant agencies, permaculture offers a radical, anti-Promethean approach to subsistence horticulture, and as such its approach to labour is at the core of its practice.

## CONCLUSION

This chapter has explored how the new materialism can enhance academic engagement with permaculture as a sustainable form of agriculture, something that chimes with Coole and Frost’s (2010) argument that some of the most significant global challenges can only be met through a new approach to material engagement that accepts its agency. It is on this basis that the new materialism adds something to the growing scholarly interest in permaculture that appears to be missing from either Bourdieusian or Latourian accounts. The new materialism furthermore, does essential theoretical work that can resolve the important questions that emerge from adopting a representationalist approach to research that sees language and discourse as the conduit between knowledge and reality.

This article has considered how people, permaculturists, actively construct “natures” and ecologies, but it is also true that the very act of construction can be othering, it perpetuates the separation between human and other-than human words. What is implied by saying “I work with nature” is that it is also possible to not work with nature – a trick of Saussurean structural linguistics that actually creates an impossible loop. Getting beyond this loop is crucial. During my ethnographic fieldwork in ecovillages I almost constantly heard about how people lived as part of nature and worked with nature, stated unproblematically. It is almost unethical to simply claim this position as absolute exteriority, and as such this chapter has simply accepted the nature category. The new materialism, and in particular Barad’s agential realism, offers a novel way to reconcile theoretical and ethnographic work on permaculture, as well as untangling some of the issues around the production of material-discursive categories such as “nature”. In this case at least, the question of agency cuts straight to the core of permacultural practice: no single thing or phenomena is seen in isolation or as unconnected to either its environment or other aspects of its ecology, nothing is inert or lacking in vitality.

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## NOTES

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1 Worm composting. Although compost worms are an essential component of any compost heap, a worm composting system concentrates worms in a sealed unit and can produce compost quite rapidly.