

An ecological cluster model for rural development projects: application in Galette Chambon, Cul-de-sac watershed, Haiti

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Abstract: Following recent natural disasters, Haitian urban areas have been submerged by large numbers of displaced rural immigrants. Rural-urban migration has resulted in what UN-Habitat calls “premature urbanization” where there is low agricultural productivity but urban areas do not generate necessary economic growth to compensate. Aid agencies, NGOs and the Haitian Government assert the need to decentralize, re-ruralise, adopt sustainable agricultural practices to reduce food insecurity and increase environmental resilience that buffers the impacts of natural hazards.

This paper responds directly to governmental recommendations to draw up regional and local development strategies and build a network of rural centres in partnership with civil society. With application to the village of Galette Chambon, this paper proposes: design solutions to watershed management, a village land zoning plan and a village centre design that accommodates eco-tourism and environmental educational facilities. We discuss the practical application of a theoretical ecological cluster model, based on observation of the traditional Lakou system and grounded in permaculture principles.



Rezime: Apre divès dega natirèl ki pase Ayiti, sa pa fè lontan, gen anpil moun ki kite rejyon riral peyi a epi yo anwayi gwo vil yo. Seksyon abita Nasyozini an genyen yon non pou deplasman moun soti nan rejyon andeyò yo pou ale nan gwo vil yo. Yo rele sa « ibanizasyon premature ». Nan zòn sa yo, pa gen anpil pwodiksyon agrikòl epi pa genyen pwodiksyon ekonomik ki ta genyen menm fòs ak devlopman lagrikilti pou ede moun sa yo viv. Ajans ki ap bay èd yo, ONG yo ak Leta ayisyen pran nòt sou nesesite pou mete sou pye yon sistèm desantralizasyon pou retounen moun yo nan rejyon riral yo, pandan yo ap devlope yon agrikilti pou soutni lavi, yon fason pou redwi ensèkrite alimantè epi ogmante adaptasyon lavi nan rejyon sa yo. Se sa ki kab sèvi kòm mwayen pou amòti konsekans dega natirèl yo ka genyen sou moun yo.

Atik sa a, se yon repons dirèk dapre rekòmandasyon gouvènman an pou kreye devlopman estratejik rejyonal epi lokal epi devlope rezo sant riral an kolaborasyon avèk sosyete sivil la. Nan atik sa a, ki kab jwenn yon aplikasyon nan vilaj **Galette Chambon**, genyen pwopozisyon pou: pote solisyon pou pwoblèm jesyon basen idwolik, yon plan pou amannaj vilaj la an plizyè seksyon, kreye yon seksyon pou touris ekolojik, ak yon espas pou edikasyon anviwonmantal. Nan atik sa a, nou pale tou sou aplikasyon teyori pou kreye yon modèl ekolojik sou fòm gwoup, ki baze sou obsèvasyon nou fè nan sistèm tradisyonèl lakou a epi ki chita sou yon prensip agrikilti an pèmanans pou ranfòse espas ekolojik la.

INTRODUCTION

Following the January 2010 earthquake, urban areas in Haïti such as Leogane, Jacmel and notably Port-au-Prince were devastated. An Oxfam report states that: “The earthquake affected rural areas directly, and more significantly, indirectly, via displacement of another 600,000 people to the countryside”¹. This rural-urban migration put a huge temporary, and continuing pressure on the ability of rural areas to feed and sustain a country which uses “...about 80% of its export earnings to pay for food imports”².

The lack of sufficient food production in rural and urban areas has resulted in “Haïti [being]... one of the most food-insecure places on earth, with 58% of the population lacking adequate

access to food”³. The lack of food and urban overcrowding is further exacerbated when rural farmers move to cities, “Unable to compete with cheap rice imports...An estimated 75,000 people stream into Port-au-Prince each year”⁴.

This rural-urban migration trend is “...what the UN-Habitat calls ‘premature urbanization’ – the agricultural sector is not productive and the urban areas are not generating economic growth. Instead, crop failures and conflicts are forcing people to flood into towns and cities”⁵.

Crop failures and a reduction in agricultural productivity is, in part due to natural disaster, but largely a result of large-scale environmental degradation, soil erosion, reduction in

1. Cohen, M. (October 2010). *Oxfam Briefing Paper: Planting Now: Agricultural challenges and opportunities for Haiti's reconstruction*. Oxford, Oxfam International. 28 p.
2. Government of the Republic of Haiti. (March 2010). *Action plan for national recovery and development of Haiti: Immediate key initiatives for the future*.

3. Cohen, M. (October 2010). *Oxfam Briefing Paper: Planting Now: Agricultural challenges and opportunities for Haiti's reconstruction*. Oxford, Oxfam International. 28 p. p. 9
4. *Ibid*, p. 8
5. Kinver, M. (2006). The challenges facing an urban world. Retrieved May 2013: <http://news.bbc.co.uk/1/hi/sci/tech/5054052.stm>

soil moisture and large scale flooding events resulting from a long history of deforestation. These impacts are felt most keenly within the watershed or catchment area that the deforestation has occurred and also indirectly via the reduction of the rural agrarian economy. With the agricultural sector accounting for more than 50% of the country's workforce [1], food production plays a crucial role in the country's economy.

These conditions make the Haitian people, their agricultural systems, watersheds and the island's ecosystems vulnerable and unable to respond to natural hazards, such as Hurricane Sandy that swept through the country in November 2012, destroying temporary shelters that had become permanent camps housing 350,000 people in Port-au-Prince displaced by the previous 2010 earthquake [2].

The Haitian government has developed an ambitious \$772M reconstruction plan detailed in the "*Action plan for national recovery and development of Haiti: Immediate key initiatives for the future.*" published in March 2010. The plan has four main themes (Territorial rebuilding, economic rebuilding, social rebuilding, and institutional rebuilding, to which environmental rehabilitation should also be added) that address various issues including improving infrastructure, increasing sustainable food production for food security and export, and planning new development centres that redistribute population and economic activities away from an overly centralized state [1].

This paper responds directly to the Haitian Government's call, "*to draw up.....targeted regional development strategies, local development plans and urban plans.... [which] are indispensable for the coordination of activities on the ground.... [that] may be carried out in partnership with the private sector and civil society*"⁶. We suggest that re-ruralising some of the Haitian population could help alleviate overcrowded urban centres. Decentralised development that creates a network of rural centres linked by new infrastructures could address the deficit in agricultural production that currently results in the importation of basic food stuffs, such as rice into Haiti.

This paper offers a practically applicable theoretical model and proposes design solutions and approaches at a range of scales. The approach is based on permaculture principles of the efficient spatial distribution of elements, the use of closed water and nutrient systems with little waste. Natural patterns are observed and amplified to generate a theoretical ecologically sensitive model for housing and living units, termed *ecological clusters*.

These *ecological clusters* provide building blocks for settlements that can create new rural development centres or be adapted and added to existing settlement. The paper aims to illustrate how this theoretical development module could be applied to the settlement of Galette Chambon, located some 30 kilometres east of Port-au-Prince (Figure 1).

The first section reviews the key recommendations and government guidance that has been published. The second discusses the theoretical aspect and methodology of this research, addressing the watershed approach and the conception of *ecological housing clusters* concept. The subsequent sections demonstrate how this approach and model can be applied to Galette Chambon, the issues and limitations that arise. The final section draws perspectives and addresses issues of implementing such a project and draws on similar projects underway in Haiti.

GOVERNMENT POLICY AND GUIDANCE ON REBUILDING HAITI

Before presenting our watershed approach and *ecological cluster model*, it is important to first understand the policy context and reflect upon some of the design guidance that has been produced on how the re-building of Haiti should be approached.

Three main documents have been drawn on: *Action plan for national recovery and development of Haiti* [1], the USAID United State Agency International Development report *Environmental vulnerability in Haiti: Findings and recommendations* [3], and the *Oxfam Briefing Paper: Planting Now: Agricultural challenges and opportunities for Haiti's reconstruction* [4]. A number of common themes reoccur throughout all three documents that are pertinent to this paper:

1. Watershed management to address issues of environmental vulnerability and degradation.
2. Need for environmental rehabilitation.
3. Decentralization through the creation of a network of regional centres with educational and agricultural research centres, linked by an expanded rural infrastructure.
4. Adoption of sustainable agricultural practices to ensure food security and increase export potential.
5. Involvement of local user groups and grass roots organizations.

The Haitian government states that "*...river basin development projects, reforestation and soil conservation projects must be conceptualized in association with rural communities and will have to match agricultural needs with the requirements of environmental protection...Farming practices must also be changed to avoid overloading ecosystems and to enter into the perspective of sustainable development*"⁷.

Leslie Voltaire, an urban planner and Haiti's special envoy to the United Nations, reiterates this need for decentralization stating "*The Haitian government now wants to lessen the strain on an overcrowded Port-au-Prince and redistribute the population to a network of smaller, sustainable communities driven by agriculture, animal husbandry, tourism, the garment sector, construction and housing*" [5].

Decentralization spreads both the population load, and future risks in the case of future natural hazards, but also provides ►

6. Government of the Republic of Haiti. (March 2010). *Action plan for national recovery and development of Haiti: Immediate key initiatives for the future.*

7. Government of the Republic of Haiti, *op. cit.*, p. 19.

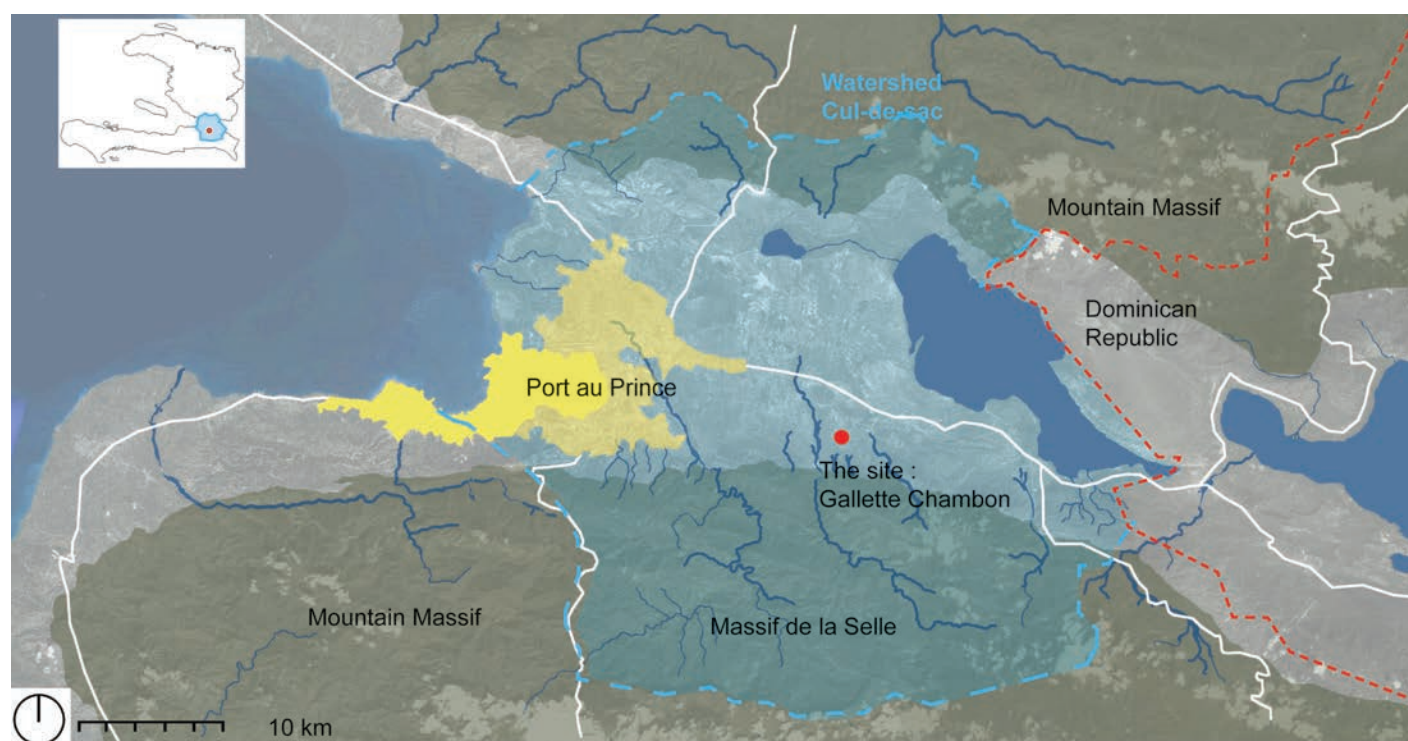


Figure 1 Context Cul de sac watershed

a network to disseminate agricultural techniques, education and health care schemes and a location to process products that further increases their economic value. The Oxfam report of 2010 advocates regional agricultural development centres, such as those run by Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) to be strengthened because, *“Decentralized provision of agricultural development services is more likely to be responsive to local needs and aspirations than a highly centralized system, particularly if there are strong civil society organizations present”*⁸.

The involvement of civil organisations brings with it local knowledge and expertise that can influence and improve design solutions and whose continued involvement increased the success of projects. The USAID report states that: *“To be effective, interventions must be part of an integrated approach, directly linking natural resource management with other pertinent sectors such as...urban planning...To be sustainable, watershed interventions must be rooted in participatory approaches with local levels of government, grassroots organizations and resource user groups”*⁹.

Changes to agricultural practices recommended include the conversion of hillsides to tree-based perennial agriculture which meets, *“high standards of soil and water conservation, mixing perennial and annual crops, benefiting from profitable marketing*

*strategies, attaining adequate rural incomes, and providing equity for upstream and downstream users alike”*¹⁰. The Oxfam report emphasises the need to *“mainstream environmental sustainability... in all agricultural and rural development policies, emphasising ...reforestation, agro-forestry, integrated watershed management and promotion of fuel-efficient stoves”*¹¹. The following section suggests at how this may be possible.

DESIGN SOLUTIONS: WATERSHED APPROACH AND THE ECOLOGICAL CLUSTER MODEL APPLIED TO THE SETTLEMENT OF GALETTE CHAMBON IN THE CUL-DE-SAC WATERSHED

Our methodology is based on a site analysis and design solutions. Cross [6] has convincingly demonstrated how knowledge can be acquired through designing, through *“presenting innovative solutions offering new insights upon which others can continue to build”*¹². The proposed design is part of a research methodology, called research by design [7], which intends to *“test a design solution and evaluate its contribution to improving an area’s spatial quality and also the degree to which these solutions may*

8. Cohen, *op. cit.*, p. 20

9. Smucker, G. R (Ed), Bannister, M., D’Agnes, H., Gossin, Y., Portnoff, M., Timyan, J., *et al.* (2007). Environmental vulnerability in Haiti: Findings and recommendations, United State Agency International Development / USAID, p. v

10. Smucker, *op. cit.*, p. iv

11. Cohen, *op. cit.*, p. 23

12. Cross, N. (2007). «From a design science to a design discipline: Understanding designerly ways of knowing and thinking». In R. Michel (Ed.), *Design Research Now, Essays and Selected Projects* (pp. 41–52). Basel, Boston, MA and Berlin, Birkhäuser Verlag AG

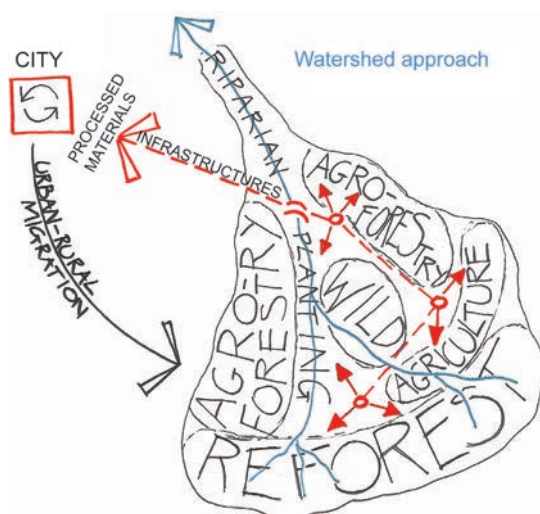


Figure 2 Watershed approach

receive public and governmental support¹³ as well as provoking new research questions.

Watershed approach

We chose Galette Chambon as a case study because of its location, which addresses issues of decentralization and the potential of rural development in Port-au-Prince's rural hinterland, one of the most densely populated watersheds in the country.

Figure 1 shows Galette Chambon's location in the south-east of the Cul-de-sac catchment area or watershed where the highlands of the "Massif de la Selle" meets the relatively flat, fertile and irrigated plane round Etang Saumatre some 30 km east of Port-au-Prince. This watershed is designated as a high priority watershed by USAID's *Environmental Vulnerability report* derived from five indices: soil potential, population vulnerability, road vulnerability, market vulnerability and irrigation vulnerability [3].

Port-au-Prince is down-stream from Galette Chambon and thus any watershed management that reduces storm water run-off and reduces peak discharge in rivers would benefit the severely stressed capital. Figure 2 diagrammatically shows the main principles of watershed management and the connection of rural centres, via an improved infrastructure network, to urban markets.

13. Van den Brink, A., & Bruns, D. (2012). « Strategies for Enhancing Landscape Architecture Research ». *Landscape Research*, vol. 1, n° 14.

The literature is rich with examples and methods to sustainably manage watersheds using techniques such as: reforestation using agro-forestry [8]; bio-engineering methods such as edible contour hedge [9] [4], Ranpay contour structures [3] and Vetiver grass lines to stabilize slopes [10]; crop rotations and composting techniques to increase soil moisture and soil fertility [11]; the introduction of bio-fuels such as *Jatropha* species [12] and rotational coppicing of timber species for charcoal production to reduce deforestation.

This paper does not seek to describe these techniques or methods in detail, but provides a land-zoning plan (Figure 3 below) that places these land-uses and techniques in the most suitable locations around the settlement of Galette Chambon.

To produce this zoning plan, we first undertook a landscape and natural resources analysis and a local survey. Land use and infrastructure were identified using aerial photography and mapping that also provided topographic and geo-hydrological information.

However, potentially valuable GIS information on slope analysis, soils, detailed terrain modelling, solid and drift geology was not available to us ►

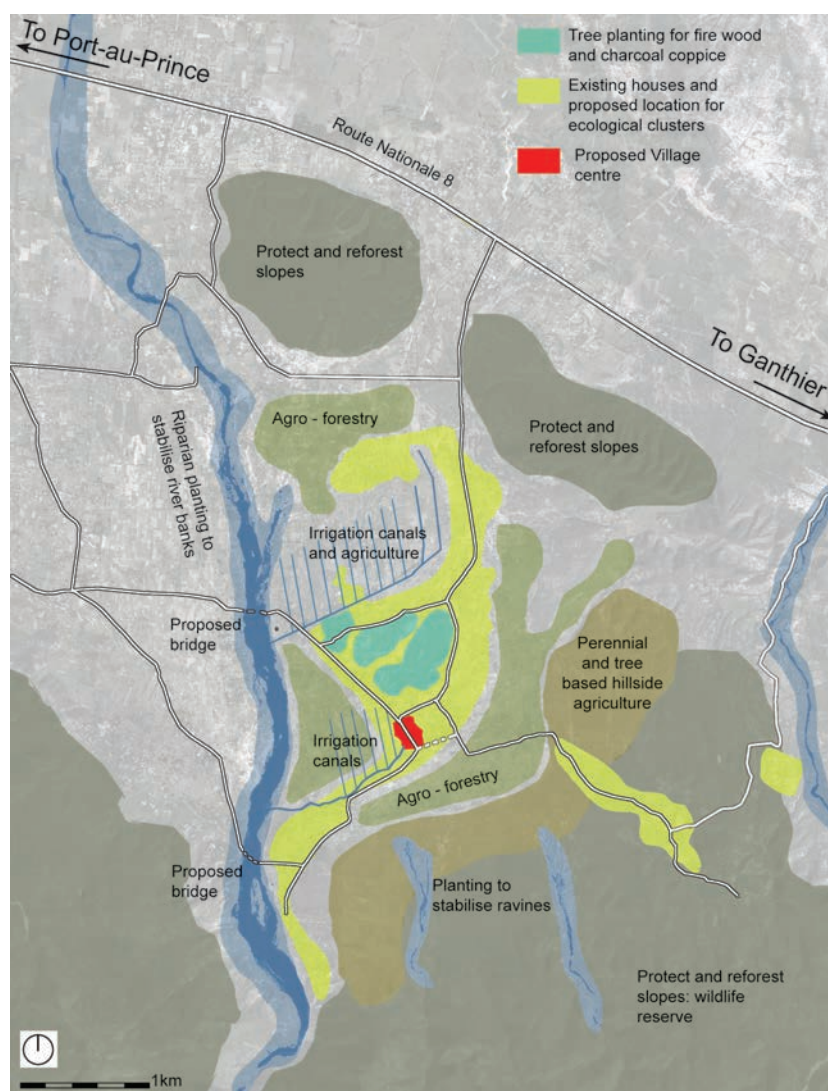


Figure 3 Galette-Chambon Land Zoning Plan

that would enable a more accurate and detailed analysis. A member of our group visited the site (Figure 9 below, shows photos) in 2011, meeting the leader of the “Assemblée de Section Communale” (ASEC) and consulted with local farmers. As a result, through an iterative design process, zones were identified for:

1. Irrigated food production that mixes perennial and annual crops on flatter more fertile areas.
2. Steeper slopes selected for hill slope agro-forestry / tree based perennial agriculture.
3. Ravines and riverbanks requiring bank stabilization and riparian planting to improve aquatic and marginal habitats and reduce flood risks.
4. Existing areas of woodland close to settlements to be managed for sustainable fire wood production, with managed coppicing introduced to provide charcoal for urban markets.
5. Steeper upper slopes reforested and protected as “wild areas” for wildlife reserves to encourage eco-tourism.

6. Improvements to local infrastructure including river crossings allowing access to markets.

Our land-zoning plan also designates areas that could accommodate more inhabitants in new ecological housing clusters, depending on land capacity. These residential clusters would increase the settlement’s population and agricultural work force, requiring in turn a larger social, spiritual, economic, educational and health centre, thus forming one of a decentralized network of smaller sustainable rural communities located in the Cul-de-sac watershed.

This land-zoning plan could be produced for other areas and form part of local development strategies that the Government calls for. The zoning of land use and distribution of elements undertaken at the village scale can be scaled up to address issues of re-forestation, slope stability, flooding and soil fertility at the watershed scale. These same issues and potential solutions are just as pertinent at the scale of individual dwellings and their immediate environment, where soil fertility is improved in small vegetable gardens and local woodland is managed to produce firewood for clusters of houses.

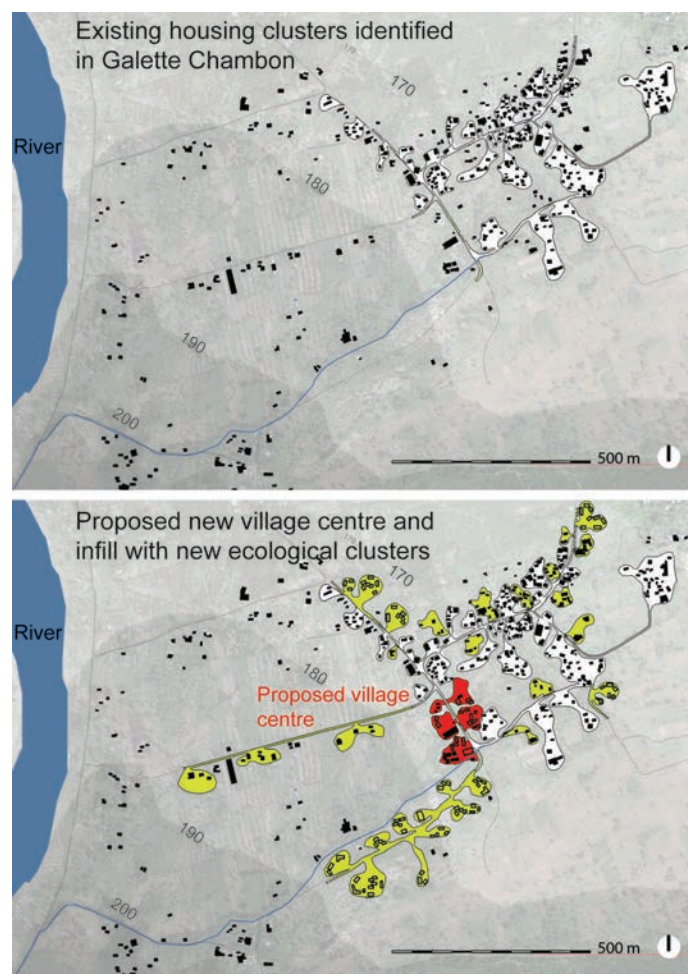


Figure 4 Ecological cluster development in Galette-Chambon

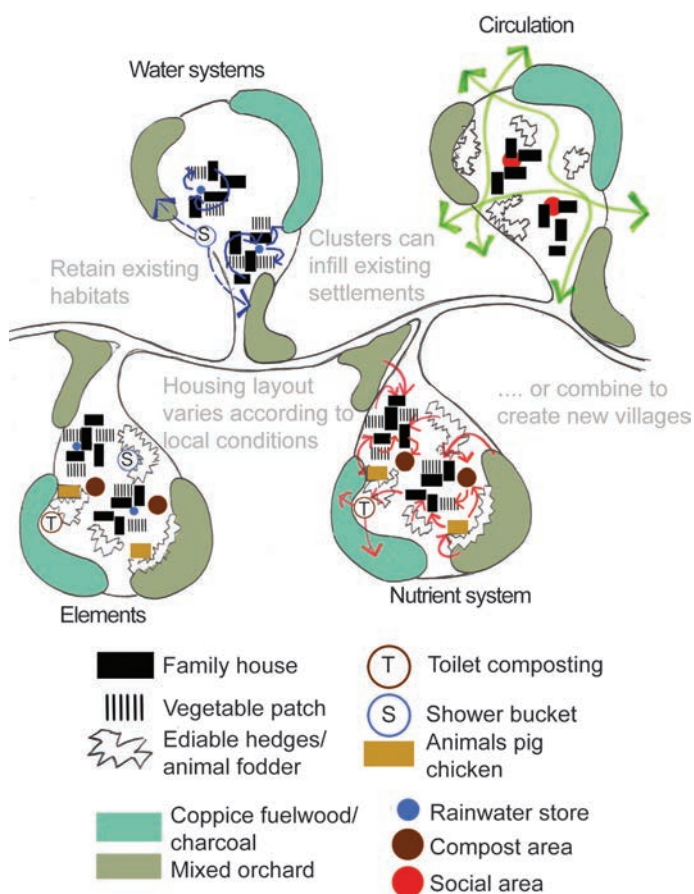


Figure 5 Ecological clusters Systems and elements

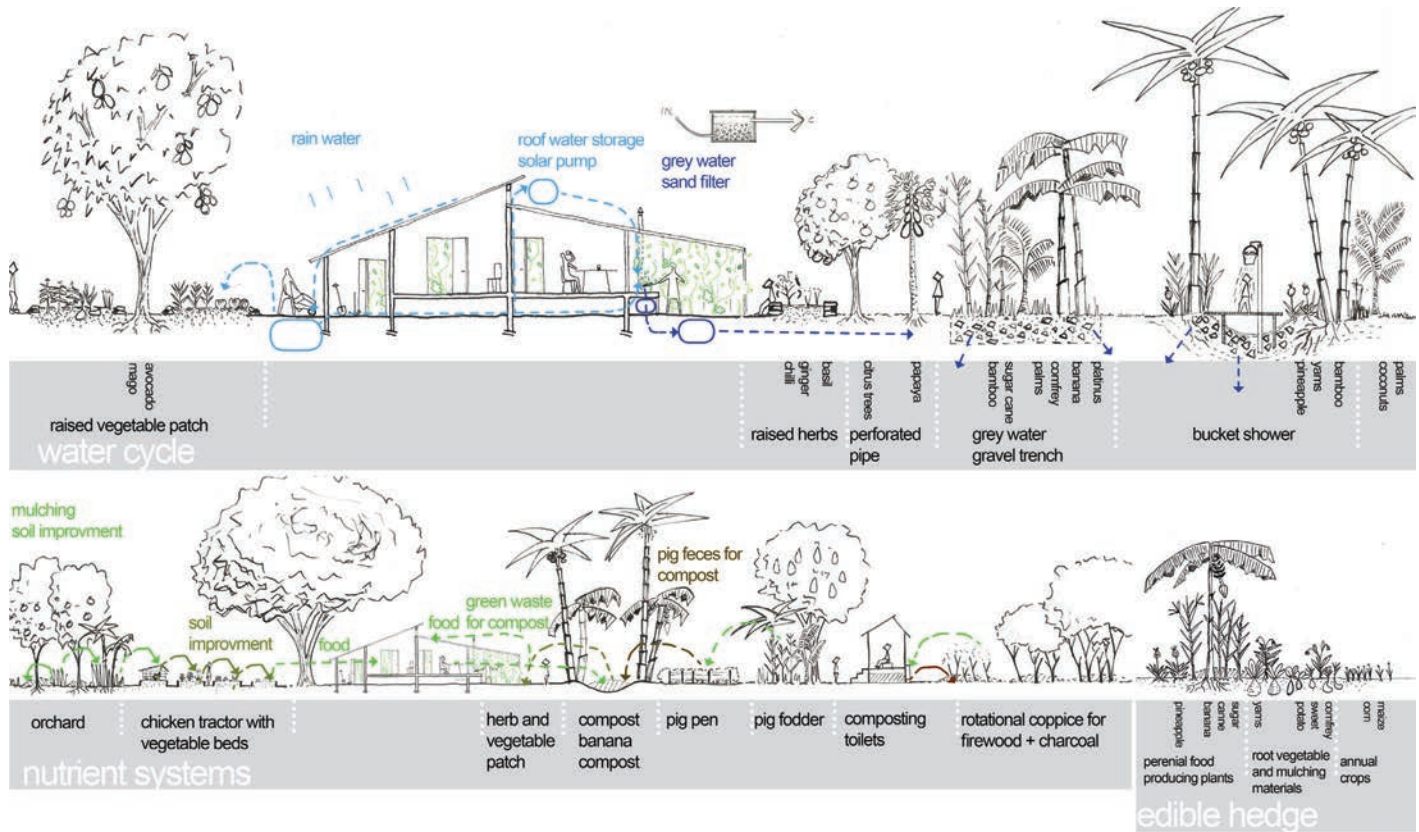


Figure 6 Water and nutrient cycle sections

Ecological cluster model

Initial analysis of the rural settlement pattern and housing layout in Galette-Chambon, using aerial imagery, revealed a repeated pattern of dwellings clustered around a series of central spaces (Figure 4).

This observation of the spatial relations between rural dwellings seemed to correspond with descriptions of a “*Lakou*”, which is a socio-economic relationship between families, based on an African system of multiple mothering: “Historically, the *Lakou* refers to a cluster of homes in which Haitian families reside, as well as to the multiple-generational family form prominent in Haitian culture” [13].

Lakou means “group living” in Creole and clusters homes around a central courtyard providing parental support, opportunities for members of a *Lakou* to work cooperatively, provides financial support and other forms of support [14] whilst continuously maintaining economic independence with individuals retaining land holdings outside of the *Lakou* [13]. There is a spiritual dimension to the *Lakou* with the courtyard used as a space for worship and as a political arena [9].

The concept of *ecological cluster models* developed out of this research and groups elements around a central shaded social space. Elements are arranged by applying the permaculture

principle of zoning sites outwardly from dwellings according to the frequency of visits needed to maintain and harvest plants and tend to animals. The various elements are placed in the most efficient spatial arrangement to increase productivity and reduce human effort [11].

Figure 5 illustrates how the various systems work in the individual *ecological clusters*. Elements include people, buildings, animals, plant associations, herb gardens, fruit trees, fuel wood production, food production systems, communal cooking facilities, compost toilets, bucket showers, nutrient and water systems.

Figure 5 and Figure 6 show the inter-relationships between these elements. One example of nutrient cycling is that of a banana compost circle where bananas obtain nutrients leached into the soil from the compost they grow around. Figure 6, below shows this and another example of nutrient cycling such as a chicken tractor, which is a rotational vegetable garden that is weeded and fertilised by chickens, subsequently planted and harvested and then weeded and fertilised by chickens whose eggs are eaten.

These *ecological clusters* are self-sufficient, autonomous and able to be adapted to different conditions using different building materials and plant associations depending on the locality. ►

Figure 7 shows how they could be used to infill existing settlements or be combined to form new settlements.

Village centre and eco-tourism

Figure 8 below is an illustrative masterplan showing what Galette Chambon's village centre could look like with the addition of a health centre with improved water facilities, market place and associated processing facilities. Grey water from the shower block is used to irrigate timber coppices grown to produce charcoal while the organic waste from composting toilets improves the soil in which the timber bearing trees are grown.

A demonstration of ecological cluster with associated plant nursery along with a new school teaching garden would create a local educational centre for all ages (to be established) that could disseminate information, seeds, seedlings, tools and agricultural techniques to the surrounding area with the support and guidance of the Ministry of Agriculture, Natural Resources and Rural Development (MARNDR).

The principles of efficient spatial distribution of elements according to the frequency of maintenance visits at the village scale places the fuel wood production areas close to populated areas. This principle is repeated at the *ecological housing clusters* scale with frequently visited herb and vegetable gardens located close to kitchens. At the watershed, village and housing cluster scale, 'wild' areas are left to allow natural regeneration and ecological re-colonization processes to occur, increasing biodiversity. These wild areas may only



Figure 7 Ecological cluster concept

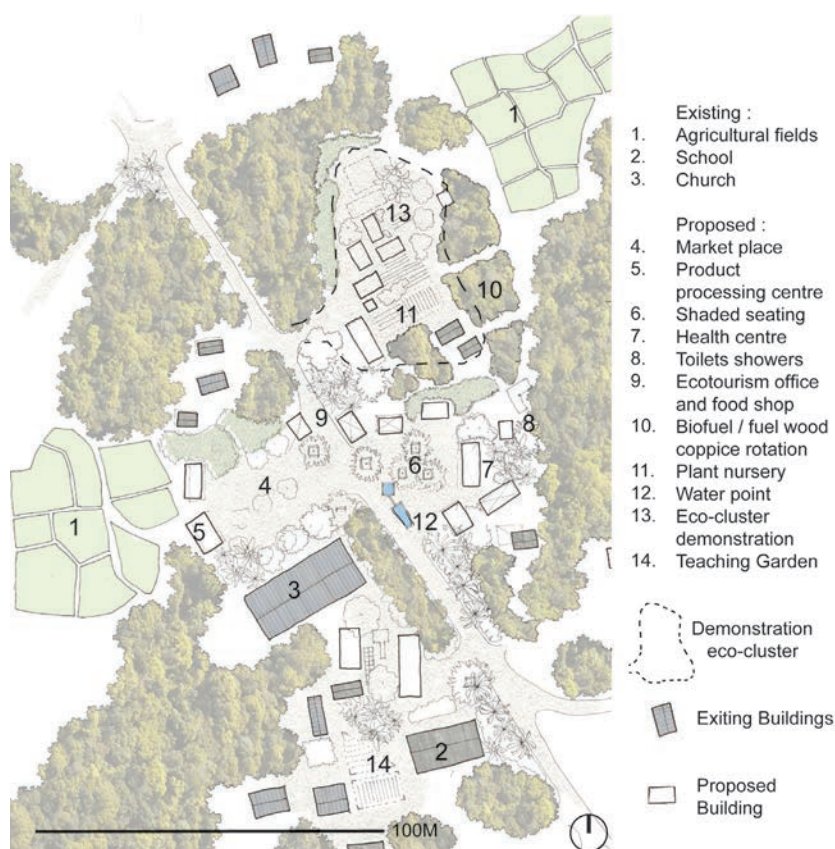


Figure 8 Proposed village centre and demonstration ecological cluster

be a small thicket near the house but much larger woodland on steep elevated land could become wildlife reserves and tourist attraction, such as "La Visite" National Park south of Galette Chambon.

Ecological clusters make use of plants associated in mutually beneficial groupings, termed *guilds* in permaculture. A guild groups plants together that provide each other with shelter, structure, soil nutrients and nitrogen amongst other elements. This approach has long been practiced in Haiti in the form of Bann Manje, meaning "a lot of food" in creole. Planted along contour lines to reduce soil erosion, in between annual crops, Bann Manje plant guilds consist of food crops that include nutrient demanding perennials such as pineapple or sugar cane that serve as the structural components, annuals such as yam and sweet potato planted to stabilise soil and produce root crops, herbaceous plants such as comfrey provide mulch and compost, while leguminous plants such as Tree Lucerne fix nitrogen and provide animals with fodder. The sections in figure 6 show these plant associations.

The demonstration areas and educational facilities could provide potential for eco-tourism, with home stays for tourists providing a source of revenue to drive the project. The settlement's location relatively close to Port-au-Prince could attract tourists en route to the near by "Parc de la Selle" (Pine Forest Reserve) National Park. Recent research into Haitian farmer's perceptions found that, "Focus group participants often saw local tourism activities as an income generating asset and a powerful incentive for conservation, by making



Figure 9 Existing site photos and proposed elements

*traditional resource management more sustainable, and by substituting degrading activities*¹⁴.

Nadine Dominique is currently coordinating a similar project to establish a permaculture demonstration farm constructed with Konbit Shelter for educational facilities in l'Anse d'Hainault in conjunction with Sciences Agricole de la Grand'Anse (UNOGA) with a potential for international exchanges of ideas through the WWOOF (World Wide Opportunities On Organic Farms) organisation. The Sadhana Forêt Haïti in Anse-a-Pitre is another example of a similar agricultural teaching centre that runs a Creole Permaculture Design Courses from teaching

rooms surrounded by plant nurseries, kitchen gardens and tetrahedron dormitories for the students.

Community involvement and the “Alliance” of cooperatives

*“Development project’s success depends not only on the understanding of biophysical conditions, but also on the socioeconomic and cultural contexts within which they operate”*¹⁵.

The involvement of the local community is crucial to any sustainable development project with an, “...increased emphasis placed on the involvement of local communities in the entire process of identifying problems of forest degradation, ►

14. Dolisca, F., McDaniel, J. M., & Teeter, L. D. (2007). « Farmers’ perceptions towards forests: A case study from Haiti ». *Forest Policy and Economics*, vol. 9, p. 704-712. p. 710

15. Urgessa, K. (2003). « Perceptions of forest cover and tree planting and ownership in Jimma Zone, Ethiopia ». *UnaSylva*, vol. 54, n° 2, p. 18-22.

*developing solutions and then implementing forest conservation programmes*¹⁶.

There are currently attempts to establish a co-operative in Galette Chambon with potential funding that would make it one of 4 co-operatives in an emerging Haitian wide “Alliance” of co-operatives who would inform and help implement any future proposals.

If this project were to be pursued in Galette Chambon then local knowledge from members of the cooperative would be crucial, as the project would be “...designed based on a more thorough knowledge of how farmers use household and field characteristics to make agroforestry decisions”¹⁷. In conjunction, environmental educational programmes for all ages would help to raise awareness and motivations for the community to become involved, and it is noted that: “Labor exchange appears to be the most fundamental kernel of self-organized and self governing institutions”¹⁸.

CONCLUSIONS

There is a need to rebuild Haiti after a series of natural disasters have severely reduced the ability of an already environmentally degraded and vulnerable country to feed itself. The continued migration of the rural population from the agriculturally productive countryside, to centralized overcrowded urban centres has further exacerbated this problem.

Government policy and numerous sources of guidance identify a need for watershed management planning, to re-forest slopes in order to reduce soil erosion, increase food and fuel wood production at the same time as decentralising Haiti and creating a network of smaller rural centres, connected to markets by improved infrastructure.

This project's aim is to sensitively integrate an increased rural population into the wider ecological and geophysical systems, and provide a model of how *ecological housing clusters* could be applied to existing settlements to relocate displaced people, thus strengthening local communities and growing economies. A more detailed study of population capacity and local, social, and leadership structures would need to be undertaken in Galette Chambon before identifying and putting in place systems to move disenfranchised urban dwellers willing to migrate to the area.

After the observation of rural housing patterns and the study of the traditional Lakou system that clusters houses around a central courtyard, we developed a concept of *ecological housing clusters* that act as small settlement units. These clusters, based in permaculture were applied to Galette Chambon in the Cul de sac watershed where a land zoning plan and illustrative landscape masterplan for the village centre were produced to illustrate how these theoretical principles could be grounded in practice.

The politically and economically complex issue of land tenure, which has been deliberately sidestepped in this paper, would have to be addressed when attempting to apply the *ecological cluster principle*. Land tenure impacts on the ability to implement large-scale irrigations projects, designate land uses and influences farmer's inclination to plant and invest in longer-term tree planting projects on land they do not control. Changes to the Government's policy of land tenure and micro funding for local communities and cooperatives to buy and manage land would help such a project to begin to be implemented. Governmental support for local centres (examples of which exist in Anse-a-Pitre and are under construction in l'Anse d'Hainault) that disseminate information, education and resources would aid de-centralisation and rural economies, provided suitable improvements to infrastructure accompanied them.

External funding for charcoal production could come from the UNEP Renewable Energy Enterprise Development (REED) that provides seed capital to small and medium enterprises producing clean energy in developing countries and achieving sustainable poverty reduction.

Our somewhat idealistic and holistic design strategy repeats the same patterns and principles at all scales to create a mosaic of inter-linked ecological clusters co-operating with each other at a community scale in the same watershed in the understanding that upstream actions impact on downstream ecosystems. From the design of the central communal court yard in the ecological housing cluster, to the designation of sustainable charcoal producing areas in the village land zoning plan, up to agro-forestry techniques to reforest catchment areas... from ridge to reef... from grandparents to children, regrowth starts by planting and nurturing seeds. ■

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**Erratum: Une erreur s'est glissée dans la version imprimée de cet article. Le nom d'Elodie Sabin aurait dû apparaitre dans la liste des co-auteurs.*

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