GROWING FUTURE HAITI

INTEGRATING EMERGENT SPATIAL DEMANDS INTO A COMMUNITY-SUPPORTIVE POST-DISASTER DEVELOPMENT STRATEGY.

Msc Graduation Thesis
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SUPPORTIVE POST-DISASTER DEVELOPMENT STRATEGY.

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Cover: Haitian painting of women at food market (artist unknown, 2011)
The 2010 earthquake caused a high level of destruction inside the urbanized areas of Port-au-Prince and its surroundings. The poor urban conditions were not capable of withstanding the natural forces that shook the earth, resulting in the loss of many lives and a multitude of displaced people. Not just the earthquakes destruction in itself, but the existing poor urban, institutional and economic conditions need to be overcome before Haiti can enter the long term development process to improve the nations livelihood and improve the quality of life of its inhabitants.

The Haitian population is among the poorest in the world, the level of food insecurity and hunger are linked to the international trends on this topic, but is also the local conditions that withhold any sustainable development.

In the search to overcome the poor conditions the population in many of the informal settlements is facing a strategy has been developed. As part of a local development framework, a spatial development strategy has been formulated that focus on an integral development approach of urban poor communities. By linking the most urgent need of basic functions and the active inclusion of urban agriculture a spatial framework that enables long-term development has been developed.

As part of the framework that focuses on local development through the empowerment of communities and local stakeholders in connection to a development of local governance and the inclusion of multiple sectorial approaches for the development of basic needs, bottom-up development of settlements is advocated. The development based on spatial entities strengthens the development of an integral approach. Problems found in the poor communities can not be linked to one cause, but are complex mix of causes. Therefore it is of great importance to have an integral development approach that links multiple individual programs together to overcome the poor conditions inside the settlements.

The strategy developed consists of a search for linking the basic needs together to create a cooperation of functions, thereby increasing the potential output. The linking of function enables the creation of a more closed system of resource flows inside the community and the involvement of environmentally strong technologies. All to not just surpass the poor state the settlements are in at the moment, but to prepare them for future developments. The developed functional network is then expanded in the form of a spatial network, laid out over the settlement to increase the potential use of the urban landscape. In the development of both network, the potential development of urban agriculture is a major aspect. By enabling urban production through the provision of land, water, and fertilizer, the community can also benefit on social and economic aspects of these development, instead of only the strengthening of the urban fabric and the settlements upgrade.
PREFACE

There is enough in the world for everyone's need, but not enough for everyone's greed (Buchman, 1947)

This thesis you are about to start reading is the last part of study process. This last piece in the puzzle became a showcase of elements of urban development I see important in the future. As part of the master of Urbanism at the Faculty of Architecture in Delft, the Netherlands.

In the context of the post-disaster environment in Haiti, this research is part of a multidisciplinary research and design studio called Urban Emergencies. This studio, developed to focus on the redevelopment process in (urban) disaster areas is part of the Faculty of Architecture, that in itself is one of faculties that form the Technical University of Delft, the Netherlands. The connection to the master of urbanism was enabled through the chair of Spatial planning and strategy.

As one of the students in the Urban Emergencies studio I had the honour to work in an international team, both in Delft, but also in Haiti itself. This trip to the destructed nation in october 2011 formed a huge inspiration for the rest of the graduation period.

Arcade fire - Haiti

Haiti, mon pays
Wounded mother I'll never see
Ma famille set me free
Throw my ashes into the sea

Mes cousins jamais nes
Hantent les nuits de Duvalier
Rien n'arrete nos espirits
Guns can't kill what soldiers can't see

In the forest we are hiding
Unmarked graves where flowers grow
Hear the soldiers angry yelling
In the river we will go

Tous les morts-nes forment une armee
Soon we will reclaim the earth
All the tears and all the bodies
Bring about our second birth

Haiti, never free
N'aie pas peur de sonner l'alarme
Tes enfants sont partis
In those days their blood was still warm

For bringing back the wonderful memories of my stay in Haiti, just by listening to this great song by a wonderfull band.
ACKNOWLEDGEMENTS

Working on a project for about one and a half years is a pretty long process during which a lot of knowledge is consumed, often for the good of this thesis, sometimes it didn’t turn out to be useful for this project. But the whole experience of gaining knowledge on topics I had not worked on before was motivating and in case of the trip to Haiti, a completely new experience.

I would not have been able to experience all this without some help and guidance. First of all I need to thank my mentors, Taneha and Diego and Alexander for the support. The many, many meetings we had together were not always the most comfortable talks. To Taneha, the support and encouragement you gave me really did help! Diego, thanks for stepping in and help me find a path to structure this chaos. Alexander, thanks for enabling the trip to Haiti, a marvellous experience.

Also thanks to my fellow urban emergencies students, with whom I had the pleasure of spending time in Haiti, work hard, discuss a lot, but most of all had a good time.

Furthermore I need to mention the many friends, roommates, and all other persons who feel involved, thanks for the support and putting things in perspective.

Last, but not least. Thanks Mam, Pap, Thijs and Bas for giving me the chance of having the possibility of studying for all those years, knowing there always are people supporting me.
EXECUTIVE SUMMARY

On January 12, 2010 the world got once again familiar with the poor situation present in Haiti. The destruction of Port-au-Prince, Haiti’s capital, was not just the result of the earthquake alone. The decades before 2010, the urban living conditions declined gradually. High levels of poverty, illiteracy, food insecurity and unemployment all contribute to these poor conditions. To increase the levels of human and social development a complex and long-term development plan is required. The earthquake and the following aid relief programs offer the opportunity to change the development perspectives of Haiti. This thesis aims at the development of a bottom up development process that includes the marginalized communities into the development spectrum. The inclusion and empowerment of this group is seen as one of the requirements for the long-term and sustainable development of the urban poor communities.

The formation of the development strategy enables bottom-up progress from the communities upwards. Through the implementation of a local development framework three different approaches on the development of the urban poor communities are combined.

While the Decentralized sectoral approach focuses on the delivery of the essential functions inside the communities, they lack a cooperation between the functions. Most often these developments focus on the technical delivery of one function, while the community requires the development of multiple functions, also to increase the efficiency of these functions, as will be show in chapter 4.4. The sectorial approach does not link with the demand-driven approach advocated in the Community support approaches. At the same time it is the lack of policy support and overview of development in neighbouring communities that decrease the efficiency of this approach. Local governance approach can support these two elements by the support on policies, having an overview of developments and create upwards accountability.

Development framework

The local development framework enables the integration of the need for development of one or more communities into a larger development spectrum. As part of this overall development framework, a development vision for the individual community need to be developed. In the form of a Community Action Plan, the end product of Participatory Planning approach, a vision for the community’s development will be formulated. This vision is developed through a series of six steps during which the project evolves itself and integrated the visions, needs and possibilities of multiple stakeholder into one strategic planning process (Fisher, 2001).

1. Project start
2. Creation of Partnerships
3. Stating of project goals
4. Analysis of the project area
5. Development of vision and implementation plan
6. Implementation of vision and follow-up

1. Project start

As said before, the unique opportunities currently present in Haiti after the earthquake offer the chance for the integration of new development approaches into the existing frameworks present in Haiti.
2. Creation of partnerships
One important aspect in the development of this strategy is the need for consensus between all the fields and stakeholders that are involved in this project. The creation of partnerships and the acknowledgement of the different stakeholders is therefore of importance to enable the development and implementation of an integral development vision. The participation of communities and thereby the empowerment of them is essential to overcome the poor urban conditions and to recognize perceived problems in the urban environment. See fig. 2 for the involvement and cooperation between the different stakeholders to form a development team.

3. Stating of project goals
Before a vision for the community’s development can be formulated, the different stakeholders all need to become aware of the goals of the project. The focus of this strategy on the development and inclusion of urban agriculture and ecological technologies into the development process are a general goal. One other general goals this strategy is aiming towards is the development and interlinking of essential urban functions. Through the addition of urban agriculture to the functional network, the functioning of the network can be strengthened, as described in point 5.1. Depending on the characteristics of the community, specific development goals can be added to this framework.

4. Analysis of project area.
Once the different stakeholders are brought together and the project goals have been formulated, the project area, the settlement, can be analysed. This process aims at clarifying the real and perceived problems inside the settlement. The involvement of the different stakeholders enables the potential of prioritizing the problems. The combined analysis strengthens the outcome of the whole project. The analysis of the stakeholders can be conducted by asking them the following questions:(Fisher, 2001, 60)

1. What is the real problem?
2. Why is it a problem? Or, what is causing the problem?
3. Why should the problem be solved?
4. When and where is it a problem?
5. Whose problem is it? Also useful in identifying a potential stakeholders.
6. What would happen if the problem wasn’t solved?
7. Once again, What is the problem?

5. Development of vision
The development of a vision for the community consists out of four different steps. The first is the linking of functions, after which a spatial network can be created. These two networks will then be proposed to the stakeholders before it is translated into a community action plan.

5.1 Linking of basic functions
The development on the local settings enable an integral development of communities. The development of the different basic facilities can be interlinked to each other, enabling high levels of cooperation between them. As described in the permaculture theory (Mollison, 1988), the creation of cooperation enables higher yield and ‘is the very basis of future survival and of existing life system’ (Mollison, 1988. 35). The linking of functions is therefore the first step in the formation of a community development vision. The need for basic facilities and functions inside the community requires an integral development of them. The linking enables the formation of a strong network in which these functions are cooperating.
Integration of urban agriculture

The major addition to the network of linked functions is urban agriculture. The benefits urban agriculture has to offer for the involved community form a valuable addition to the development program. Not just the production of foods influence the performance of this strategy. The need for water for irrigation and fertilizer offer the opportunity to integrate the reuse and composting of grey water and organic and human wastes. The need for filtration of grey water offers the potential of integration ecological strong technologies. A series of rain gardens and wetlands incorporated in the spatial framework can upgrade the community through the implementation of green elements upgrading the quality of the urban environment. Same as for the productive grounds, the urban greening influences the climate inside the settlement.

Next to the provision of water and fertilizers, the other element that need to be provided is land for production facilities.

Formation of the urban structure

In order to implement the linked functions into the community, six spatial elements are formed that together enable the formation of an urban web structure (Salingaros, 2005). The elements consists out of multiple aspects of the linked functions network to increase the incorporation of the functions into each other.

The first are the productive grounds that function as the main basis for production. These spaces also incorporates the composting facilities and constructed wetlands as part of the water filtration system.

Second, the housing development. The integral approach in this strategy forms the basis for the housing developments. Sanitation, grey water filtration and waste management are incorporated into the development program.

Third is the development of socio-economic facilities on strategic locations inside the community to support the social and human development of the community.

Fourth, a network of roads to enable the connections between the nodes. Swales are incorporated into the road design to allow drainage as part of the water network inside the community.

Fifth, slow infrastructure lines that have green characters. The provision of public spaces are important for the strengthen en formation of social activities in the community.

Sixth, are the water lines that carry the collected and filtrated water from the housing developments and road surfaces towards the productive grounds.
The elements developed will be implemented into the project area to form the spatial framework that enables the different connections made to function. Figure 5 shows the spatial development vision for the Tisous community. The formation of this vision is described in chapter 6 of this thesis.

Last step in the formation of the Community Action Plan is the formation of basic interventions that can form a spatial framework for the development of housing facilities and enables the integration of the different parts. Through four design principles the connections can be implemented into the urban environment.

The first is the design of **green-blue lines**. In case the green, slow infrastructure lines coincide with main drainage lines, these lines should be designed as linear wetlands that filtrate the water and offer green public spaces.

Second, the creation of **links towards the main infrastructure** enables the integration of the development in the existing community.

Third is formation of **small scale public spaces** that support the interaction inside the community. These spaces can be used as pocket parks of play grounds.

Fourth is the orientation **towards sun and wind directions**. The development of corridors for the wind to flow through and shading creates cooling effects inside the urban environment.
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Before we can start working on the project it is important to understand the context of Haiti and this research project. As first an insight in the personal motivations of why and how this project can to light and what my personal goals are. The second part of the introduction focuses on destruction the 2010 earthquake caused and how this effected life in Haiti and the nations food supply. Third and fourth parts are reflections on the 2010 earthquake and the history of Haiti to get familiar with the complex situation present in Haiti.
1. INTRODUCTION

1.1 PERSONAL MOTIVATION
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1.4 A GENERAL INTRODUCTION OF HAITI
1.5 BRIEF HISTORY OF HAÏTI
1.1 PERSONAL MOTIVATION

In the aftermath of the 2010 earthquake that hit Haiti hard and destructed a major part of the urban environment of the Nation’s capitol Port-au-Prince the world was horrified by the images that appeared in the news. The helplessness of the local population and the struggle to deliver sufficient aid and emergency relief to the population in need of medical, food and other aid was heart-breaking.

Once the possibility to develop a research and design project in this context appeared this chance seemed like a once in a lifetime opportunity. Although at start Haiti is a difficult and unfamiliar context, over time the complex situation of this country started to become clear and partially understandable. The possibilities to work in one of the poorest countries in the world and help rebuild a part of the urban fabric of the city, thereby directly helping the local population, is therefore a major driver to deliver a clear plan. A plan almost ready for integration into ‘the real world’.

Working under these conditions is not only an opportunity to improve the urban conditions in Haiti, it also grasps back to the basic elements of urbanism and urban development. Due to the lack of any form of organized urbanization in combination with the complex present situation, the solutions need to be sought in basic and simple interventions that improve the underlying structure of the city instead of adding modern urban developed applied in western cities.

One of the first images that grasped my attention was the image of the Haitian and Dominican republics’ border. The line that politically separates the two nations is actually visible in real life. The ongoing process of deforestation in order to supply charcoal for energy consumption, and as fuel for daily use such as cooking, destructed the entire natural resources the country once possessed.

I started questioning myself how people are able to survive under these conditions. Once you start reading into how the global food system works and keeping multiple aspects such as global food price rise, the linear connection to oil and chemicals and the disrupted global metabolism, in mind, you start wondering how long this system is able to support the world’s population.

The global food problem in combination with the local food insecurity in the aftermath of the earthquake and even before 2010 motivated me to start working on a research project dealing with this phenomenon and the connection food has with cities and urbanization processes. Can the present situation be changed for the better in order to change the perspectives for the future?

Fig. 1.1 Border between Haiti (left) and Dominican Republic (Cobb, 1987)
The situation in Haiti after the earthquake is depressing, the living conditions in the city of Port-au-Prince are hard. The city is dense, dirty and clogged up with traffic. Buildings and infrastructure is destroyed and even two years after the disaster a lot of rubble is still present in the streetscape. The redevelopment process will take on many years or even decades and it is unclear if the most severe hit areas, mostly informal settlement, will be developed to become more integrated into the larger city creating possibilities to overcome the poor living conditions suppressing the potentials of the local population.

To overcome the state of exclusion and the poor living conditions this project will aim at the development of strategy of using a series of spatial interventions that create the potentiality to develop social, economic and environmental programs that enhances the overall development of informal settlements while the community is an active participant in the development process.

The pressing situation of informal settlements requires the development of basic functions to support the quality of life of the people living in these conditions. In addition to the development of basic functions, this project focuses on the integration of food processes in the city. By creation urban production sites and link the food production process to daily urban processes, the mutual benefit that can be created will strengthen the urban environment on social, economic and environmental goals.

The research on the combination of both and the development of a strategy for the development of both is therefore the main objective of this research.

Summarised the objectives of this project are:

- The search for possibilities to integrate urban agriculture into development processes of informal settlement or other marginalized urban areas creating beneficiary connections between the separate functions and actions to strengthen the overall development process and influence the outcome of the project towards settlements of high quality that support the community development instead of restraining.

- The development of a strategy in which the connection between urban agriculture and urban development is strategically combined to create perspectives of developments that can support the build up of involved urban areas into more inclusive, self-sustaining and livable settlements that are part of the larger economic, social and environmental network of the city.
1.3 JANUARY 12 2010 | 34 SECONDS LATER

34 seconds, during that short period of time the future of Haiti changed completely...

At a distance of about 25 km outside of Port-au-Prince near the town of Léogane, an 7.0 magnitude earthquake hit the country. The city of Port-au-Prince was severely hit, along with Jacmel towards the south and Léogane, so close the epicentre, was for 90% destroyed.

In Port-au-Prince it were mainly the areas where the urban poor lived, the biddonville’s, build along hillsides on

Although the official death toll doesn’t give a clear number -estimations between 50.000 to 300.000- (BBC News, 2011), the amount of 1 to 1.5 million homeless people do give a clue of the scale of destruction this natural disaster caused.

Due to the already poor shape Haiti was in, the effects of the relative mild earthquake resulted in wide spread destruction and the effected the already poor population of the densely crowded Port-au-Prince and surroundings harder then anywhere else. Not only the destruction the earthquake caused is the problem. The whole social, economic and political state Haiti is in, made this earthquake to one of the largest natural disasters ever.
In the two years after the earthquake the international community, led by the United Nations on collaboration with the Haitian government, started the relief work, helping the affected population in all sorts of ways. But even two years after there are still around 500,000 people living in internally displaced persons (IDP) camps in, mainly, the Port-au-Prince metropolitan area. The lack of proper WASH facilities and the poor living conditions, not just in the IDP camps, in combination with an ongoing Cholera epidemic forms a major public health threat.

Next to that, only half the rubble has been removed in two years time and the economic and political situation the country is in, seriously impedes the reconstruction progress. The presidential elections in the fall of 2010 resulted in the election of Michel ‘Sweet Mickey’ Martelly. But it took until October 2011 to form a new government due to political impasses.

The lack of sufficient progress in the redevelopment process resulted in the construction of ±100,000 housing units in two years time, out of the 250,000 claimed by the earthquake. The same goes on for the development of WASH facilities and the set up of livelihood structures.

A large part of Haiti’s population is earning their money in small scale agriculture or in the informal sector. There is a lack of financial and technical support to create any proper forms of livelihood in these economic sectors.

The problematic situation of the development of Haiti can be related to several different factors. The main reasons are the absence of political support due to the missing government in a major part of 2011 and the failure of the international community to come up with the promised financial support for the redevelopment of the country. Since the approvalment of Martelly’s cabinet, the political power to structure the redevelopment seems to have made progress, but there still lacks a political body for a redevelopment program.

Fig. 1.3 Palais Nationale, Port-au-Prince
1.4 A GENERAL INTRODUCTION OF HAITI

To be able to understand the situation in Haiti, it is good to know a little bit more about the country and the social and economic conditions it is in.

<table>
<thead>
<tr>
<th>Official name:</th>
<th>Republik d’ Ayiti ( Haitian Creole); République d’Haïti (French) (Republic of Haiti)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form of government</td>
<td>Republic with two legislative houses (Senate [30]; Chamber of Deputies [99])</td>
</tr>
<tr>
<td>Head of state</td>
<td>President</td>
</tr>
<tr>
<td>Head of government</td>
<td>Prime minister</td>
</tr>
<tr>
<td>Capital</td>
<td>Port-au-Prince</td>
</tr>
<tr>
<td>Official languages</td>
<td>Haitian Creole; French</td>
</tr>
<tr>
<td>Official religions</td>
<td>1 (Catholic)</td>
</tr>
<tr>
<td>Monetary unit</td>
<td>Gourde (G)</td>
</tr>
<tr>
<td>Population</td>
<td>9,649,000 (2010 est.)</td>
</tr>
<tr>
<td>Total area (sq km)</td>
<td>27,700</td>
</tr>
</tbody>
</table>

Fig. 1.4 Haiti statistics (Encyclopædia Britannica, 2011)

Geographic location

Haiti is located on the western one-third of the island of Hispaniola, together with the Dominican Republic on the eastern two-thirds of the island. The country has a surface of 27,750 sq km, compared to 41,543 sq km of the Netherlands.

Natural disasters
Since Haiti is part of the hurricane belt, the country is regularly hit by tropical storms or hurricanes, but also subjected to drought, flooding and earthquakes (Central Intelligence Agency, 2011).
In the Human Development Index of the United Nations, Haiti is ranked under the Low Human Development countries at number 158 (of 187) (UNDP, 2011). This number is an overall view on the statistics of Haiti, showing the poor position the country and its population is in.

Looking at the World Bank data (The World Bank Group, 2011), the social and economic indicators show a similar trend. The level of human development in Haiti is among the worst in the world.

<table>
<thead>
<tr>
<th>Poverty rate</th>
<th>54% (&lt;$1.25/day) 77% (&lt;$2/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of literacy</td>
<td>49% of people ages &gt;15 years</td>
</tr>
<tr>
<td>Life expectancy at birth</td>
<td>61 years</td>
</tr>
<tr>
<td>Percentage of urban population with access to improved sanitation</td>
<td>24%</td>
</tr>
</tbody>
</table>

These numbers also show the poor health situation the country is in. A life expectancy at birth of only 61 years, is shockingly low. This number can partly be explained by the high level of poverty and food insecurity in combination with a poor medical care.

**Spatial developments**

The country's environmental degradation is a main constraint in the development of the country. The high level of deforestation, only 3% of the original forest is left, is one of the largest environmental problems. Not only is the loss of flora and fauna a major concern. Also the high level of soil degradation and loss of fertility are forming huge constraints on the agricultural developments. (USAID, 2010). Next to that, the high level of deforestation forms also a major hazard. The lack of vegetation on hillside doesn’t prevent the soil from eroding and during a earthquake or during heavy rainfall the soil is vulnerable to sliding away forming a major threat for lower lying areas.
1.5 A BRIEF HISTORY OF HAITI

Since the discovery of the island of Hispaniola by Christopher Columbus in the year 1492 until nowadays Haiti has been a country unlike anyone else in the World. Its history has seen many different phases both of glory and of despair. This chapter will conclude some of the most important phases in the country’s history leading up to now.

**Colonisation and independency**

After the discovery of the later named Hispaniola by Columbus the native population was enslaved to work on the fields and gold mines of the Spaniards. By introducing cattle, pigs and horses the Spaniards changed the natural landscape of Hispaniola.

After the treaty of Rijswijk in 1697 France formally gained the control over the western part of Hispaniola. During the next century Haiti became one of the most prosperous colonies in the world. A large part of the French wealth was developed in the Caribbean. During the period of occupation Haiti was developed into the world’s leading sugarcane producer, earning its nickname ‘the pearl of the Caribbean’ supporting the growth of the France.

![Toussaint Louverture](https://example.com/toussaint_louverture.jpg)

**Fig. 1.7 Toussaint Louverture (Vatican Assassins, 2011)**
The Haitian revolution

The 18th century was a period of many violent conflicts between the white colonists and the black enslaved population of Saint-Domingue. The working conditions on the plantations ruled by the French colonists, who controlled the slave population with force to prevent them from revolting. In the second half of the 18th century runaway slaves (Maroons) started to perform hit-and-run attacks on the plantations to secure provisions and weaponry, but also to revanche themselves against the owners of the plantations (Metz, 2001).

Starting in August 1791 after the formulation of a pact, during a vodou ceremony, by the rebellion leader, including François-Dominique Toussaint Louverture, the revolt started. The result was the slaughter of all white people in the slave bands encountered. When the news reached La Cap (Français) the white population repressed the black slave population to suppress the revolt over there. The first attempt of the slave bands to take control over La Cap resulted in massacre, forcing the withdrawal. But the event was one of the first steps in the Haitian revolution. The unrest in the whole of Saint-Domingue triggered both the Spaniards and the British to become involved in the revolution.

During the following years the battle for Haiti the Haitian born Toussaint Louverture fought together with both British and Spanish troops to gain control over Saint-Domingue. Where the British focussed on the southern part of the island, the Spaniards fought for the control of the northern part of the island. While both the British and the Spanish promised free rights for the enslaved black population, they both didn’t hold their words, resulting Toussaint Louverture to pledge his alliance to France, who did confirm to abolish slavery (Metz, 2001). Towards the beginning of the 19th century Toussaint Louverture gained control over the whole of Hispaniola.

But in 1802 around 16,000 French troops arrived on the shores of Hispaniola to once again make the island part of the French Republic, now under control of Bonaparte Napoleon. Before Toussaint Louverture surrendered himself to the French on May 5, 1802, his Haitian commanders Jean-Jacques Dessalines and Henri Christophe transferred their allegiance to the French. After the capturing of Toussaint Louverture and the restoration of slavery in Martinique both Dessalines, Christophe, and Pétion started to battle the French army once again. And once the war between France and Britain resumed once again in 1803 Napoleons’ focus shifted towards the European continent once again, ending the French occupation in Haiti creating the nation of Haiti.
1804 - The first black republic

By signing the independence on the first of January 1804 Haiti became the second free country in the Western Hemisphere and the first black republic in the world. The country had to start all over again. The war had destructed the countries agriculture and under the control of Dessalines as the new leader of free Haiti, the planation system was reintroduced. The lack of improvement of the general population and the use of the military as a tool to control made Dessalines lose his support, especially under the mulattoes. In October 1806 Dessalines was murdered during a mulatto revolt. His murder and slaughter is presumably ordered by Pétion, a mulatto leader.

The assassination of Dessalines resulted in a civil war between Pétion (mulatto) in the south and Christophe (black) in the North. Both leaders claimed rule over the area, Christophe as a king of a kingdom, with the capitol in Cap-Hatian and Pétion as the president of the republic with the Capitol in Port-au-Prince (Encyclopædia Britannica, 2011). Where under Christophe’s rule the land in the north was distributed by the king, Pétion divided the available land into small plots and gave them to the population. The use of these small plots resulted in a lack of commercial agriculture since all farmers were mainly producing for themselves. A system that can still be seen today (Metz, 2011).

After the death of Pétion in 1818 and Christophe’s suicide in 1820 Jean-Pierre Boyer became president over the whole nation. Under his rule Haiti invaded the Spanish part of Hispaniola rejoining the both countries and forming one nations. But nations agricultural production was lacking the capacity to support economic growth under Boyer’s regime.

An extra burden for Boyer was the 150 million Francs that needed to be paid to France for the official recognition of the countries independence, further stagnating the economy of Haiti. In the coming years the pressures between different social groups and also towards Boyer and his regime grew, resulting in a new revolution in 1843 forcing Boyer to flee the country. Starting a period of instability seeing many different heads of states. In between 1843 and 1915 Haiti has seen 22 heads of state, of whom 21 were either killed or forced to resign (Encyclopædia Britannica, 2011).
The American influence (1915-1934)

A combination of civil unrest and political instability in Haiti and foreign political motivation, were the preface of the occupation of Haiti by the United States of America. In 1915, American troops landed in Port-au-Prince. After several decades of political instability and unrest the US marines started to restore the control in Haiti. During the first years of American involvement, unrest accumulated until 1918, when a rebellion was suppressed by the new Haitian gendarmerie with help of US marines (Metz, 2001). Followed by years of order.

Another effect of the American occupation of Haiti is the start of an era in which Haiti renewed itself. The infrastructure was build up, roads and bridges were constructed, telephone networks and water systems, connecting smaller cities to the water network. Next to that, the Americans launched health care programs.

Downside of the American occupation was the discrimination of the black Haitian population. Only a small, mainly mulatto, elite was able to become involved.

After an incident involving US marines in Las Cayes, president Hoover formed two commissions who researched the influence of the American occupation of Haiti. The commission led by Forbes concluded that the material improved by the Americans had to be praised, but the exclusion of the Haitian population in the real politics was criticized. Leading up to the removal of the US Marines in Haiti, transferring the control back to an Haitian government (Encyclopædia Britannica, 2011).

Duvalier dictatorship

After the Americans left Haiti, another period of political insecurity started. In the period leading up to Duvalier’s control, the country has seen several presidents, a revolution in 1946 and a coup. During the free elections in 1957 the Duvalier was elected after projecting himself as the ideal candidate seemingly without a strong ideology (Metz, 2011).

But during the first years of his presidency, especially after a failed coup by the military, Duvalier ruled over the country with military force. He had control over his own paramilitary group called the Tontons Macoutes (Creole for boogeyman). This group was responsible for the control over the rural parts of the country.

During the presidency of Duvalier, the Haitian economy reduced, international aid relief retracted and the tourism declined. Also internationally Haiti became isolated during the regime of Duvalier, while at the same time Haitians fled the country and moved to mainly America and the Dominican Republic (Metz, 2011).

After the death of ‘Papa Doc’ in 1971, Duvalier assigned his sun Jean-Claude Duvalier as his successor. Internationally Jean-Claude became known as ‘Baby Doc’. He tried to restore the international relations and the tourism sector in Haiti. But after a series of violent demonstrations in 1986, Baby Doc was forced to flee to France.

Fig. 1.10 Duvalier Family, Papa & Baby Doc.
(Public Domain, 2011)
The years after the end of the Duvalier regime in Haiti, the country held its first free elections in 1990, resulting in the presidency of Jean-Bertrand Aristide. Already after eight month Aristide was deposed by the military general Cédras, who suppressed the opposition, resulting in international trade blockades. Starting a drain of the population.

In 1994 the government stepped down, bringing Aristide back in power. Together with almost 20,000 American soldiers Aristide started working on reform of Haiti into a more modern country.

Aristide was succeeded by one of his associates René Préval. Who had to step down after political fights with Aristide’s companions, leading up to fraudulence elections in 2000. Which in their turn were the start of more international sanctions. Creating the hard conditions Aristide had to work with after his return as president in 2001 (Encyclopædia Britannica, 2011).

During his second term as president was accused of corruption, and during the celebration of the 200 year liberation violent demonstrations made Aristide to step down and flee, like many of the other rules needed to do.

In the aftermath of the Aristide government, the international community order US armed forces to stabilize the situation and oversee new elections. The UN stabilization mission in Haiti, MINUSTAH is an Brazilian led working on the general security in Haiti while the interim government was working on organizing free elections. After the new election of Préval, mainly supported by the poor in the slums, in 2005 a new difficult period started for Haiti (Encyclopædia Britannica, 2011). In 2008 the rise of (global) food prices resulted in riots in mainly the slum areas. And in 2008 and 2010 natural disasters displaced many people.

At the moment Michel Martelly is the elected president after the elections in 2010 and 2011.
Within this chapter the global and local food problematic is explained to get a grip on the topic of food insecurity and the effect on life. This, one of the many present problems, is translated into a problem statement that clarifies the potentials this thesis is focusing on. Together with the research question, the methodology formulates the research that will be conducted in the next steps.
2. PROBLEM STATEMENT

2.1 HAITI’S & WORLD’S FOOD SYSTEM
2.2 PROBLEM STATEMENT
2.3 RESEARCH QUESTIONS
2.4 METHODOLOGY
2.1 HAITI’S & WORLD’S FOOD SYSTEM

Millennium goal 1C:
Halve, between 1990 and 2015, the proportion of people who suffer from hunger (United Nations, 2010)

Fighting hunger is one of the eight Millennium Development Goals (MDG) formulated by the United Nations in 2000. As part of the first MDG, Eradicate extreme poverty and hunger, the number of undernourished people in development countries should be less than 10%. The global food system is related to many different factors. All with their own level of influence, also in urban development.

Food security

In the western world where all kinds of food are available year round it is hard to imagine that there are places in the world where there are people with insufficient access to nutritional resources to sustain their living. In 1996 the FAO & World Food Program stated the official definition of the term food security:

Projecting this knowledge on the world the number of food insecure people reaches an amazing and confronting number of ± 1 billion people (FAO and WFP, 2010). Especially after the world’s food price crisis in 2008, the number of undernourished people in the world grew dramatically. In 2010, the number is expected to decline again. In combination with the global economic crisis, the food price crisis the total percentage of undernourished people still remains high, about 16% in 2010, far above the 2015 MDG. These people lack the possibility to gather or buy the sufficient amount of nutrients due to several causes.

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern.

Food insecurity exists when people do not have adequate physical, social or economic access to food as defined above (FAO and WFP, 2010).
Food security in Haiti
By just looking at the numbers given by the food security portal (IFPRI, 2011) the state of food security in Haiti becomes clear as a shocking one:

- 57% of the people undernourished
- 22% of the children undernourished
- 1850 kcal per day per person (Min intake between 1750 and 2030 KCal p/d)

On the Global Hunger index, Haiti scores an 28.0 (IFPRI, 2010).
This number indicates that in general the level of hunger in Haiti is alarming, and even close to extremely alarming (>30).
This number is a combined factor of
1. the percentage of undernourished population,
2. the prevalence of underweight in children under the age of five,
3. the mortality rate of children under the age of five.

These combined indicators together form the calculation for hunger.

These numbers indicate that a large part of the population in Haiti is not able to feed itself sufficiently due to several reasons. Some of these factors that influence the high level of food insecurity are explained below.

There are several interlinked aspects related to the level of food security. Some are of global concern, some are specific for Haiti and enhanced by the earthquake. Below these aspects will be explained to show the relation between the urbanisation process and the food insecurity. First the global ones, food prices, population growth and the production methods causing stress on the food security. Second the factors that relate to Haiti’s specific conditions, the poor agriculture sector and the effects of the 2010 earthquake.

World food prices
On of the factors highly related to food security and undernourishment are the world food prices. Although, in real terms, the global food prices has declined, but since the beginning of the twenty-first century the food prices have been increasing (Fig 2.2). One of the major influences on the food price is the price of oil. Due to the globalized production and transport of food, transport costs are a large part of the actual food price. So with increasing oil prices, the price of food increases significantly. Other factors are the increased demand in China and India and the use of grains for biofuels contributed to the increasing price levels.

Since the absolute peak in 2008, the prices have decreased, but still are well above the prices before the crisis. Above that, the declining food prices are slowly transmitted to domestic markets, meaning that the people only slowly see the decline of food prices at the actual markets.

In combination with the economic and financial crisis of the last years, the purchasing capacity of a growing number of people increased the number of undernourished people worldwide, due to reduced incomes in combination with remaining high food prices. The growth of the proportion of undernourished people in developing countries can be seen in figure 2.3
Worlds Population growth
It is generally known that the twenty-first century is the century of the city. During the coming decades the world will become more and more urban. Already 50% of the world’s population is living in urban areas. This transformation from an rural to an urban world is even seen as a new step in the evolution of mankind, the Homo Sapiens will transform in the Homo Sapiens Urbanus (UN Habitat, 2010).

This transition towards an urban population plus the overall growth of the world population will have a major impact on the use of natural resources.

In the latest report on the worlds land and water resources by the FAO, *The state of the world’s land and water resources for food and agriculture*, the organisation is stating that the world’s agricultural production needs to increase by 70%, and 100% in developing countries, up to 2050 in order to be able to produce the needed amount of agricultural products, food, construction materials and, bio-fuels included (FAO, 2011b).

In that report the FAO also warns for the upcoming problematic areas where the state of the agricultural land are degrading. A major concern is the combination of land degradation and the areas with high poverty rates, creating a poverty trap for the poor who rely on small farm plots of poor quality and most vulnerable too climatic changes. The world’s poorest population has the least access to land and water. The lack of technological advances contributes to the land degradation.

In the light of this knowledge we can start asking ourself question about how we deal with our natural resources. It seems that there needs to change something in the way we use and think about the agricultural products we use. Especially when the parts of the world who are starting to become urban are going to use the ‘western’ way of living, not thinking about the things we use and how we get all the products we need in our daily life. This also relates to the system of disengaged production and consumption for most of the products we use.
Intensive production methods
Since we got so used to the availability of food and the use of agricultural resources, it is hard to think about how the system behind all of it works. How difficult it actually is to have all the products we eat, drink and use at such a high rate of availability in front of us, ready to use. Almost all the those products are not grown and produced locally. The food market is a global market, based on intensive production and processing and cheap transport based on oil. A common phrase for this is ‘oil based agriculture’.

In the past couple of decades the agricultural production world wide has grown by 150%, but only 12% of agricultural land (FAO, 2011a) has been added. This growth of production is mainly based on chemical fertilizer and mechanization of the production process. In addition to this, the shipping of products all around the world to end up in the supermarkets and shops in the developed country creates a huge impact on the environment.

Intensive agriculture not only effects the environment due to the effect oil-based production, it also the impact on the ecology is not without concerns. The often massive scale of production and thereby also mono cultural production types, makes the product more vulnerable for pest and disease, creating an even bigger demand for chemical and unnatural fertilizers. Next to that, the mono cultural production also impacts the local biodiversity by eradication of local and native flora and fauna.

On the other hand you also have the aspect of intensive agricultural production. The combination of far from home production and anonymous retail of food in supermarkets has detached the consumer to the product. In present times the (emotional) bond between production and consumption has been lost. More and more products are sold as ready to eat and mainly in the western culture food is nothing more then something we have always available. But people forget the effort it takes to produce and the qualities it has to offer over all the processed products we eat.

Agricultural sector in Haiti
Agriculture is one of the main economic forces of the country and one of the pillars of the Haitian economy and is one of the main sources of employment (USAID, 2010). The fact that agriculture is seen as one of the nations most important sectors to help the nation develop, a vision stated by the Haitian government(MARDNR, 2010), must set up a framework for the development of the agricultural sector. Strengthening the agriculture must help the country to develop in the coming years. But there are several elements blocking the agricultural sector from flourishing. These causes can be related to the economic and political state of the country and the lack of development in this sector.
Agricultural sector

The agricultural sector in Haiti is subjected to several challenges that constrain developments in the agricultural sector, despite the importance of agriculture for Haiti’s economy (FAO, 2012).

Lack of irrigation, rain fed agricultural production

Only a small part of Haiti’s agricultural is based on a system of irrigation (FAO, 2012). Most of the agricultural production is rain-fed and regularly subjected to drought. Next to that is the existing irrigation system poorly maintained and demolished during the earthquake. Making the agricultural sector even more vulnerable. There are no official statistics of the irrigation system (MARNDR, 2010).

Infrastructure bottlenecks

The state of Haiti’s infrastructure is far from ideal. Not only is the physical conditions of the national road in a bad shape, also the infrastructure connecting market and production locations is (partly) missing. One of the results of the lack of sufficient infrastructure is the loss of products. Many perishable foods rot on the stop, with losses up to 35%. Next to the physical infrastructure, post-harvest infrastructure, like processing plants and storage locations is missing.

Environmental degradation

The Haitian landscape is mountainous with many of the hillside uncovered with trees that can hold the topsoil from spoiling away after (heavy) rainfall. Due to the environmental degradation and the large scale of deforestation, the once arable soils has eroded away, resulting in an loss of fertility, reduction of water quality and quantity in the agricultural production zones. Meaning the crop yields are even lower, due to the absence of fertilizer. Next to that, 85% of the country’s watersheds are deteriorated or transformed, leading to regular floods.

Population shift

The shift of the population increased the need for food products in the urban areas. In the 70s and 80s the rural production was capable producing enough food for the urban market. But the increasing urban population and the changing diet created a shortage in the non urban areas.

Trade liberalization

Opening up the economy started the import of cheaper food from abroad. In the case of rice, the import of cheaper rice from the US disrupted the internal market. Where in the ’80 rice was only eaten once a week, nowadays rice is eaten almost everyday. While the demand of rice increased, the local production cannot compete with the increasing import of cheap rice. At the same time, the import of cheap rice also affected other markets. The change in diet also decreased the demand for other stable crops like maize. At present time the level of food imports exceeds the level of internal production, 51 to 43% with an extra 6% of aid imports. Comparative to the 19% import in 1981, these explain the weak agricultural sector.

Agricultural Trade Balance (US$ millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total exports</th>
<th>Agricultural exports</th>
<th>Agricultural exports as a % of total exports</th>
<th>Total imports</th>
<th>Food imports</th>
<th>Food imports as % of total imports</th>
<th>Trade deficit</th>
<th>Food trade deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>343.5</td>
<td>24</td>
<td>7%</td>
<td>1156</td>
<td>266</td>
<td>23%</td>
<td>-813</td>
<td>-242</td>
</tr>
<tr>
<td>2001</td>
<td>300</td>
<td>15</td>
<td>5%</td>
<td>1116</td>
<td>279</td>
<td>25%</td>
<td>-816</td>
<td>-264</td>
</tr>
<tr>
<td>2002</td>
<td>286</td>
<td>20</td>
<td>7%</td>
<td>1073</td>
<td>236</td>
<td>22%</td>
<td>-787</td>
<td>-216</td>
</tr>
<tr>
<td>2003</td>
<td>360</td>
<td>18</td>
<td>5%</td>
<td>1218</td>
<td>268</td>
<td>22%</td>
<td>-858</td>
<td>-250</td>
</tr>
<tr>
<td>2004</td>
<td>420</td>
<td>21</td>
<td>5%</td>
<td>1250</td>
<td>325</td>
<td>26%</td>
<td>-830</td>
<td>-304</td>
</tr>
<tr>
<td>2005</td>
<td>483</td>
<td>29</td>
<td>6%</td>
<td>1379</td>
<td>331</td>
<td>24%</td>
<td>-896</td>
<td>-302</td>
</tr>
<tr>
<td>2006</td>
<td>500</td>
<td>30</td>
<td>6%</td>
<td>1673</td>
<td>368</td>
<td>22%</td>
<td>-1173</td>
<td>-338</td>
</tr>
<tr>
<td>2007</td>
<td>560</td>
<td>28</td>
<td>5%</td>
<td>1609</td>
<td>370</td>
<td>23%</td>
<td>-1949</td>
<td>-342</td>
</tr>
<tr>
<td>Average</td>
<td>406.5</td>
<td>23.12</td>
<td>6%</td>
<td>1309.25</td>
<td>307.37</td>
<td>23%</td>
<td>-340.25</td>
<td>-234</td>
</tr>
</tbody>
</table>

Fig. 2.5 Agriculture Trade balance (USAID, 2010)
Influence of the earthquake

The 2010 earthquake had quite an impact on the agricultural sector of Haiti. Both directly and indirectly in the period following the earthquake. The direct consequences are the destruction of agricultural infrastructure and housing of the rural population in the area affected by the earthquake. The Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR) calculated that the total damages run up to USD 31 million, of which USD 26 million is agriculture infrastructure like storage and processing facilities, irrigation systems and, roads. An overview of these costs can be seen in figure 2.6.

The direct consequences of the earthquake for the agriculture are mainly due to the movement of a part of the urban population to the rural areas, increasing households from 5-6 persons per household before towards 10 people after the earthquake (MARNDR, 2010). This migration provoked the amount of available food per person in the household. Leading to a depletion of food stocks, increasing risk for food insecurity. But also to an increase of food prices in these rural areas, where most of the farmers can not profit from since most of the production is used for domestic needs. Creating a downwards circle of production and consumption potentials.

The productive landscapes that were affected by the earthquake suffered important losses of the irrigation network. Research by the MANDR showed the destruction of the irrigation canals due to the earthquake, or the successive landslides and debris. Within the irrigated agriculture areas, the revenues succeeded the pluvial agriculture in the mountains, resulting in a greater loss of concrete buildings and structures (MARNDR, 2010).

<table>
<thead>
<tr>
<th>Description</th>
<th>Public (USD)</th>
<th>Private (USD)</th>
<th>Total (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation Infrastructures</td>
<td>1,640,000</td>
<td>410,000</td>
<td>2,050,000</td>
</tr>
<tr>
<td>Roads</td>
<td>200,000</td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td>Food Processing Infrastructure</td>
<td>375,000</td>
<td></td>
<td>375,000</td>
</tr>
<tr>
<td>Administrative Building of the Ministry</td>
<td>23,650,000</td>
<td></td>
<td>23,650,000</td>
</tr>
<tr>
<td>Loss and Deficit in Production</td>
<td>2,000,000</td>
<td>3,000,000</td>
<td>5,000,000</td>
</tr>
<tr>
<td>Total</td>
<td>27,865,000</td>
<td>3,410,000</td>
<td>31,275,000</td>
</tr>
</tbody>
</table>

Fig. 2.6 Estimate of the losses in the agricultural sector (MARNDR, 2010)
2.2 PROBLEM STATEMENT

In the coming decades it will be the urban poor who will be hit hardest by the changes the world is experiencing at the moment. Climatic change, global food problems, demographic changes such as the exclusion of this group in daily urban processes are the main challenges to overcome. The people in informal and marginalized urban settlements with no perspective to full participation into the local and global social and economic processes are the ones who will experience who are the most vulnerable.

One of these processes is the increasing depletion of natural resources. Presently, in modern societies the availability of necessary resources is not of any concern. Resources are harvested at one side of the world, shipped to other parts of the world, consumed and remains are wasted. The system of production, processing, transport, and marketing is based on the availability of cheap fossil fuels, that until recently were available at a constant low price created this shipment of nutrients all over the world. Contributing to a oil based society of which it is said that ‘we’ are eating oil (Girardet, 2000).

A result of the unequal connection towards food and other essential resources is the large amount of people struggling to get sufficient amounts of foods to support daily activities. The scaring number of 1 billion people who are suffering of hunger worldwide gained a lot of attention. One in every seven persons worldwide is unable to satisfy their daily needs, making hunger the number one health risk (WFP, N.D.).

Haiti is one of those most vulnerable places in the world. The 2010 earthquake that devastated the country strengthened the poor state of the country. A large part of the country is living in poverty unable to reach participate in development processes. The urban poor living in the many informal settlements inside Port-au-Prince lack any form of spatial, social or economic integration. The location of these settlements in hazard prone areas makes them so called poverty-traps, of which the population is lacking opportunities to improve their livelihood. These existing conditions need to be overcome in order to enable any form of development of the urban poor living in these marginalized settlements and start the bottom-up development of the impoverished country.

The combined aspects of post-disaster redevelopment, the exclusion of the urban poor, and the need for new models of urbanization that are supportive to the community and less resource consuming create the opportunity for the creation of development strategy.

This document focuses on the integration of these three aspects to enable bottom-up development of informal settlements. The focus of this search will lie on three main principles:

- Empowerment of local communities to enable bottom-up developments,
- Creation of networks of functions and spaces that support urban, social and economic development,
- Integration of urban agriculture and other sustainable technologies for the sustainable development of informal settlements.
The main research question in this research is:

Which spatial interventions are needed in order to make urban agriculture an integral part of sustainable development plans for informal settlements in Port-au-Prince as part of post-disaster integral redevelopment plans?

Other questions needed that are part of this main research question are:

- What is the role of agriculture in urban areas?
- How can the addition of agriculture in urban areas influence spatial planning?
- How to integrate informal settlements on the larger scale?
- How can post-disaster redevelopment be linked to sustainable urban planning?
- How can agriculture be combined with sustainable urban development?
METHODOLOGY

This project comes forth out of a Urban Emergencies studio at TU Delft. The studio focuses on the urban and architectural challenges of disaster relief. In this light the project context focuses on the relief of the 2010 Haiti earthquake, in combination with the personal interest in the world’s food problem, forming the base for this research and design project.

After a research of both situations the problem statement was formulated. The combination of one the one hand the need for redevelopment plans for Haiti and on the other hand the global problem of food security in mainly the poor areas is the main problem to be worked on in this project. Although on first thoughts these two problems might not be linked to each other, they do influence each other.

After a first research of these problems, the search for possible solutions will start. After the formulation of research questions, the theory on both problems and approaches on resolving the problems will be explored. The result of this theoretical research will be formulated in a hypothesis. The hypothesis will form the backbone of the next steps in this research.

The analytical framework will form the basis for a general design approach for this project. By analysing the location with a fixed framework the problems, that need to be solved in order to answer the research question, will come to light. Goal for this step is to develop a general framework of analysis that can also be applied on other (similar) situations and as a tool for urban development including urban agriculture.

This framework will focus on the projects location in Port-au-Prince. The analysis in this part will form the base for the vision, the first step towards the design. The use of this analytical framework depends on the scale of intervention the framework is used for. It can be applied to several scales of analysis, from city to neighbourhood, to plot.

The vision will be created by using the methods developed in the previous steps. Next to this overall vision for the project area, simultaneously specific design interventions will be designed showing the individual interventions in the urban fabric.

A final step in this project is the formulation of possibilities to expend the project to a larger scale and/ or in different places around to world, to come up with an answer to the question how generic this project is.
In order to be able to answer the problems statement, back information on the different aspects connected to this project need to be researched to get an understanding of theories. Themes of urban development, urban agriculture, permaculture and urban network are researched before conclusions in the form of a hypothesis is stated. The hypothesis is the preliminary answer to the research question that need to be formulated and tested later on in this project.
3. THEORETICAL FRAMEWORK

3.1 LOCAL DEVELOPMENT FRAMEWORK
3.2 URBAN AGRICULTURE AS URBAN DEVELOPMENT TOOL
3.3 URBAN WEB DEVELOPMENTS
3.4 PERMACULTURE
3.5 HYPOTHESIS
3.1 COMMUNITY SUPPORT DEVELOPMENTS

The planning of urban development is a delicate process involving many different aspects of urbanization. During a top-down planning process, master-plans were used to implement the better world envisioned by the planners of the modernistic era (UNHSP, 2009). Inspired by the frontrunners of the modernistic movement, Le Corbusier and Frank Lloyd Wright, many countries around the world have been implementing modernists principles in the urban development of their cities. The modernistic standards of urbanization are unrealistic for the urban poor and low-income households, excluding them from the planning arena and pushing them into unplanned and excluded areas (UNHSP, 2009). At present times, with an rising critique against the modernistic movement, searches for new planning processes have been conducted. Seven of these new planning approaches described by the UN-Habitat Human Settlements program (2009, p.60) are:

1. Strategic spatial planning and its variants;
2. New ways of using spatial planning to integrate government;
3. Approaches to land regularization and management;
4. Participatory and partnership processes;
5. Approaches promoted by international agencies and addressing sectorial urban concerns;
6. New forms of master planning; and
7. Planning aimed at producing new spatial forms.

In developing countries the disconnection between central governments and the urban poor excludes that last group from active participation into the urban development process. The urgent need for development of this group requires the active involvement of communities in order to satisfy first needs through which community can be build up supported by a clear development framework. The participation and empowerment of communities helps to overcome the poor urban conditions the urban poor are living in.

Participatory and partnership processes
Including the beneficiaries into the planning process is the main aspect of this planning approach. It is believed that by involving the stakeholder with the highest interest, the beneficiary, into the planning process, will empower communities and build social capital, leading to better designs of urban projects and allow participants concerns to be incorporated within strategies (Mansuri and Rao, 2004, UNHSP, 2009). Depending on the level of partnership the community can be included into the decision making process on a communicative basis, or gain more control over the budget and decisions on a communicative basis.

Including the local community, the beneficiaries, into the planning process can overcome the neglected state of these communities by a central government. Urban poor communities and informal settlements often lack information and need for documents, excluding them from state-provided services (Narayan et al., 2000), while at the same time participatory community driven development can reverse the relationship between the poor and any governmental body.
The lack of strong governmental bodies support the need for community based developments. The lack of a central organizing party, creates conditions that decreases the opportunities of the vulnerable urban poor. Where the most support is needed for the population to create an urban environment that creates opportunities for its inhabitants to socially and economically participate in the daily processes of the urban environment, this support is not available due to the different stakes of a central government and the urban poor. Mainly living in informal settlements, the urban poor form a group that is excluded from the planning process. They are the ones that benefit the least from the planning process.

The lack of top-down development processes creates the opportunity for the development of bottom-up developments that include the urban poor into the development process and can support a struggling central government through the small scale development of a more inclusive city (UN Habitat, 2010).

The main principle of participatory planning is the active involvement of the local community and other stakeholders in the different stages of the planning process. In equal relation to the professionals, the community can be involved in the analysis of problems inside the urban environment. The knowledge of the community can be used to prioritize problems and identify perceived problems.

The small scale developments that can be started without the organisational or financial support of a central government and lead by the local community can strengthen the local social capital -defined as the ability of individuals to secure benefits as a result of membership in social networks- (Dongier et al., 2002).

During a set of actions the local community can be mobilized to actively participate in the development and decision-making processes to, in the end, formulate a Community Action Plan (CAP). The use of the CAP as a settlements development vision, that integrates the stakeholders visions and possibilities into one overall development vision, depends on many different aspects. In order to enable the implementation of such a vision it is recommended to include the CAP into a development framework that supports an integral development of the community.

**Local development framework**

One such an approach that includes the empowerment of local communities, but also supports an integral development of human, social, and economic is the local development framework (Helling et al., 2005). This development approach enables the development of an integral system of functions that support the community to build up their own environment with the support of a local governance and the technical support of the sectorial approach.

![Local development framework](image-url)
Through a set of seven elements, four core and three enabling, the framework that combines the three approaches, 1) community support, 2) local governance, and 3) decentralized sectorial (fig 3.2), can be created to enable the local development. These elements are:

Core elements:
- **Empowerment** of the population creates opportunities to express opinions and make choices either through individual resources or through social capital that provides a basis for collective action.
- **Local governance** is the way authority is organized, legitimated, and employed by and on behalf of local people through planning, decision-making, rule enforcement, and accountability processes.
- **Local service provision** systems—including public sector, private sector, non-governmental, and community-based organizations—mobilize and manage resources and produce public facilities and services.
- **Private sector growth** at the local level requires improving economic infrastructure and services; strengthening human, social and institutional capital; and creating an enabling business climate.

Enabling elements:
- **The policy and institutional environment** for local development includes formal institutions such as laws, government policies, and organisational systems, as well as values, norms, and social practices that influence people’s decisions and behaviour.
- **Capacity enhancement** includes establishing the local institutions through which people and communities participate in local development as well as strengthening of human, social, and institutional capital.
- **Resource transfers** to local actors—public, non-governmental, and community-based organizations—include the provision of investment and operational funding as well as support for training, technical assistance, and information.

The local development framework integrates previous attempts of community support approaches in combination with two other development approaches, decentralized sector and local government approach. The three approaches combined, forming the local development framework, support the empowerment of the urban poor in combination with more local levels of governmental support.

The combined approach towards local development creates the potential to overcome the disconnection between sectorial developments while the demands of the local population is used to create a demand driven development with support of local governments that have increased accountability. Local development frameworks aims at the creating of a single inclusive development process, either governmental or aid-financed driven, that focuses on three objectives (Helling et al., 2005):

- **Increasing local access to public infrastructure**, public services, and economic opportunities. Access requires proximity. Integrating processes at the local level helps bring a variety of facilities, services, and economic opportunities closer to where people live and work.
- **Increasing the empowerment of local actors** in ways which support good governance, effective and equitable service provision, and broadly based livelihood improvements by strengthening citizen voice and choice in local decision-making and increasing accountability to local civil society.
- **Enhancing the sustainability of local development processes** by strengthening the institutions, capacities, and collective resources that constitute the capital stock for local development.

It is this combined focus that makes the local development framework suitable for the development of a community action plan (CAP) developed during a participatory planning process that combines the needs and wishes of the community and the knowledge of experts on different sectors, such as urban development.
Why Local development?
The combined aspect of the three development frameworks, fig. 3.2, all relate to the development of local communities. The several links and differences in these processes provide both cooperative and competitive principles that need to be combined.

While the Decentralized sectorial approach focuses on the delivery of the essential functions inside the communities, they lack a cooperation between the functions. Most often these developments focus on the technical delivery of one functions, while the community requires the development of multiple functions, also to increase the efficiency of these functions, as will be show in chapter 4.4. The sectorial approach does not link with the demand-driven approach advocated in the community support approaches. At the same time it is the lack of policy support and overview of development in neighbouring communities that decrease the efficiency of this approach. Local governance approach can support these two elements by the support on policies, having an overview of developments and create upwards accountability.

The spatial approach advocated in the local development framework supports the integral development of the involved communities, commune, or region, depending on existing governmental bodies. It support the development of interlinked functions that together can fight poverty, support healthcare or education (Helling et al., 2005). Decentralizing government and development assistance programs enables interventions to be more effectively tailored to diverse local conditions.

Empowerment
Empowerment supports the development of the community through the creation of voice, social capital and active participation. In combination with the development of local governance the upwards accountability, empowerment of urban poor creates the potential for sustainable developments. Sustainable in the sense of accepted and truly used developments that support the development of the community on the long-term, instead of unused top-down planned development that does not integrate with the local community.

Including the urban poor into the development process and enabling them to improve the local urban conditions not only enables them to improve their urban environment. The increased participation and acknowledgement of these groups also creates ‘real’ freedom. Giving people a voice, gives them the possibility to participate in public debates and speak out their core values of development, such as nourishment or education (Dongier et al., 2002).

Fig. 3.3 Linked approaches as part of a Local development framework (Helling et al., 2005)
3.2 AGRICULTURE AS URBAN DEVELOPMENT TOOL

In the light of empowerment of local communities, urban agriculture is one of the many possibilities of bottom-up developments. Of all the potentials urban agriculture has, the strengthening of the urban environment and the use as an empowerment tool at the local level are the main interesting. The impact on socio-economic level can contribute to the livelihood and lifestyle of urban dwellers makes urban production more than just production (Mouget, 2000). Through these potentials, urban agriculture forms a valuable addition to the bottom-up development spectrum of marginalized communities.

The world of urban agriculture
Reintroducing food production and other agricultural activities in the urbanized area is more than the creation of green and open land to produce products that can be used in the city. The close connection between production spaces and the rest of the city gives the possibility to influence each other, creating a more inclusive and self-sufficient urban area, which enables the movement towards a more sustainable urban body. The so-called urban agriculture movement describes the possibilities for urban production as following:

"... an industry that produces, processes, and markets food, fuel, and other outputs, largely in response to the daily demand of consumers within a town, city, or metropolis, on many types of privately and publicly held land and water bodies found throughout intra-urban and peri-urban areas. Typically urban agriculture applies intensive production methods, frequently using and reusing natural resources and urban wastes, to yield a diverse array of land-, water-, and air-based fauna and flora, contributing to the food security, health, livelihood, and environment of the individual, household, and community" (Smit et al., 2001, 1).

Essential in this statement is the acknowledgement of the different elements that are involved in urban agricultural production. The different forms and possibilities of agricultural production are supported, as well as the many possibilities of land that are suitable for production. Smit enhances the symbioses between agriculture and urban areas but stating that the production is in response to the urban demand and the use and reuse of urban wastes, both solid and liquid.

The reestablished connection between food production and consumption is a major effort in the light of sustainable urbanisation. The expected growth of the world’s urban population and the increasing demand of natural resources in the ever-expanding urban areas all around the world, puts the system under immense pressure. The increased use of natural resource for the urban lifestyle creates a one-way flow of resources from all over the world towards the cities. The linear form of metabolism that funnels the resources from all over the planet to urban areas not only depletes the natural landscape, creating more vulnerable areas, it also produces a immense amount of waste.

The close connections in urban agriculture are supportive to sustainable developments that ‘enable all its citizens to meet their own needs and to enhance their well-being without damaging the natural world or endangering the living conditions of other people, now or in the future’ (Girardet, 2000, 8).

Next to that, urban agriculture can close the created disconnection between the urban environment and the supportive rural lands (Mouget, 1994, Steel, 2008).
Production possibilities in the city

Within existing urban areas there are plenty of possibilities for the production of foods. Almost all open spaces inside the urbanized area can be used for some form of agricultural production. Within both developing and developed countries many examples of productive land use can be found, ranging from small scale homegrown production to large scale commercial production along the urban fringe. There is no fixed spatial element for the production sites. Among the most commonly production locations are (Smit et al., 2001):

- Housebound production: In gardens or on rooftops are ideal locations for small production for private use. With modern developments, also vertical farming along walls becomes an option.
- Communal spaces: are spaces of production that are shared with multiple stakeholders. Community gardens can be found in e.g. parks, institutional grounds, land unsuitable for habitation or vacant strips of land inside communities.
- Surplus and reserve spaces can be found in all parts of the urban area. Spaces next to main infrastructure, like airports or highways, unsuitable for habitation, forms and ideal base for production activities.
- Water streams, bodies, wetlands and floodplains. Water inside urban areas can be used for water based production methods such as aquaculture (fish production) and aquaponics (combined aquatic and horticulture production). Mainly the use of flood prone areas not suitable for habitation forms a excellent base for production facilities.

The close connection and access to urban resources and an easy access to the market creates to possibility for urban agriculture to generate a fast response. The availability of resources such as (waste) materials and labour that can be used during production makes it possible for urban production to perform well and support urban life. On the other hand, urban production has the potential to strengthen rural agriculture, instead of competing with it. Mainly due to the closeness to the urban demand and the short time between production and marketing makes urban agriculture a great addition to the food resources. Mainly perishable products or products with a low urban demand are ideal for urban production. Urban agriculture has the potential to adapt itself easily to a changing urban demand. This flexibility is one of the main benefits of urban production over rural production.

It is important to keep in mind that urban production will not substitute rural production. Although most current cities are based on the ‘supermarket’ model, extracting foods from the outside, the production capacity inside urban bodies is insufficient to satisfy the market. Complementing the rural production with perishable products is the main task of urban production. Doing so makes it possible for the rural production to shift to a more sustainable model of production. The change in production create potential for rural production to shift to more valuable production for both the urban market and export, generating more income. Mainly in the less developed countries, this can transform the agricultural sector in a positive sense.

The transformation and strengthening of the urban landscape creates the opportunity of progressive development of settlements. This aspect is of major importance for the creation of long-term and environmentally strong development plans for marginalized settlements in developing countries, such as Haiti.
**Benefits of urban agriculture.**
The addition of agricultural production can, as stated before, influence the livelihood and lifestyle of the urban dweller on many aspects. The benefits of urban agriculture ranges from socio-economic to environmental aspects as can be seen in figure 3.6.

**Socio-economic benefits**
The large range of agricultural possibilities inside the urban fabric and the different scales it enhances also create social and economic effects at different scale levels from personal or household to city level. The creation of local production systems inside communities creates the possibility for people to actively participate in the process of food production and become involved in their own food security. Not only will this improve the amount of available food, improving the level of food security and nutrition and creating access to a higher quality and less expensive range of products, due to shortened time period between harvest and consumption, enabling the urban poor to decrease the expenditures on foods(Quon, 1999). The involvement in production can help the involved household in the decrease of the food expenditures -running up to 50% for low-income households- and generate income if surplus products are sold(De Zeeuw et al., 1998, RUAF, 2009), creating possibilities to increase expenditures on nonfood activities such as education, that at enables employment in these functions, creating an upwards spiral of development.

Next to the contribution of urban agriculture to poverty alleviation, of which empowerment of communities is another important aspect (World Bank, 2001), it also contributes to health improvements of the involved population. It contributes to a more diverse diet of less processed, high sodium foods. It also contributes to a better mitigation of diseases, i.e. AIDS/HIV, through improved nutrition and improved physical exercise(De Zeeuw and Dubbeling, 2010).

The social aspect of urban agriculture comes forth out of the abilities of agricultural activities to develop social structure and capital within communities while at the same time individuals can develop their own form of social benefits. The ability to produce food and thereby actively contributing to the food security of the household is a major benefit of developing agricultural activities; the increased self-esteem, proud and acceptance on household and community level are others. If urban agriculture is used on a community scale, the benefits range from enhanced social connections, creating social safety nets to improved social security all by the improved community building(Smit et al., 2001).

Easy access to participation in agricultural activities creates the opportunity for unskilled youth or housebound women to become actively involved in the economic circle. Urban agriculture has the potential to play a major role in the urban economy. The high economic base of food, since food is a major basic need with a constant demand(Dubbeling et al., 2010).

The development of a chain of production, processing and marketing of products within the urban areas will heavily contribute to the development of economic activities and employment, with the major benefit that the added value will stay in the local area, enhancing the economy of the location(Dubbeling et al., 2010).
Environmental benefits

Next to the socio-economic benefits urban agriculture has to offer, the possibility for urban agriculture to enhance the environmental goals of an urban area is immense. Introducing agriculture in the city will influence the eco-footprint of the city and can establish and improved metabolism while it also enhances the natural landscape in the city.

Most of the cities in the developed countries attract a large flow of products and nutrient from all over the world towards them. The disconnected production and consumption result in an impressive movement of products around the globe, resulting in a use of fossil fuels to ship food from one of the globe to the other. Combined with the high level of chemical fertilizers used during the production and storage of food, the commonly used phrase of ‘eating oil’ is more than correct (Paxton, 2005). The close relation of production, processing and marketing creates the possibility to shorten this circle, reducing the amount of food miles to local proportions, having a major effect on the eco-footprint of the city (Smit et al., 2001).

On the other hand, the close connection between production and consumption can have a positive effect on the local urban metabolism. Instead of the present linear metabolism, urban agriculture contributes to a circular metabolism. Meaning that local nutrients will be used and waste reused during the production process, reducing the amount of waste materials leaking into the natural environment. In the case of the nutrients, the close by consumption of the nutrients prevents the global movement of them, reducing the depletion of nutrients at other places in the world, what is happening at the moment. The soil system can be kept in balance through the active use of the soil and the most active top layers. The use of organic fertilizers instead of chemical ones creates the potential to produce similar amounts of food, all through natural processes. It also prevents the loss of energy during the transport of foods. It is estimated that during the transport process products consumed 600 times more energy as they contain (Girardet, 2000).

The use and re-use of organic waste materials, liquid and solid, can be done in the form of the use of waste water, or use of domestic organic waste as excellent fertilizer during the production, instead of chemical fertilizers. At the same time solid inorganic waste can be used during the construction, packaging and storage of foods inside the urban area (Deelstra and Girardet, 2000). Also the close relation between market and production decreases the demand for heavy packaging for transport over long distances by boat or plane. Reducing the required amount of products. It is important to note that use of domestic organic waste and wastewater is not a simple task. Health issues are important to keep in mind and prevent pollution of soil, foods and water sources. Mainly the use of animal excreta as fertilizer should not be underestimated. Another major benefit of urban agriculture is the link with climate change and the urban climate. The addition of green elements in the urban fabric increase the biodiversity, creating strategies for mitigating the effects of climate change by enhancing the range of flora and fauna inside the city that can be used for greening the city of production. The increased amount of green elements inside the city contributes to micro-climatic improvements by lowering temperatures, urban heat island effect, and increasing the humidity, improving the physical climate of the city (Deelstra and Girardet, 2000). It also contributes to the reduction of pollutants, improving the air quality and improvement of rainwater collection through the development of ‘green lungs’ (Dubbeling et al., 2009).

Projects implementation

Many informal settlements face the low level of development, thereby disabling the development of its community. Enabling the start of urban agricultural projects can start an upwards upgrading process of the urban environment to support the community. The marginal conditions on landuse, water and waste management and semi rural settings found in settlements on the fringe of Port-au-Prince offer the opportunity for enabling urban production as part of a development process. Tisous is such a settlement in dire need for supportive visions of development.
The local use of urban agriculture

Urban agriculture is mostly developed as a singly developed, small scale project that has only limited effects on the urban environment and population. The same principles applied in these small projects can also be used to form the urban fabric. Using the Continues Productive Urban Landscapes (CPUL) theory, created by Viljoen and Bohn (2005) as base for the formation of the spatial elements of an urban agriculture network. The theory uses urban agriculture as base for the creation of continues green lines through the urban system, linking existing open and public spaces together connecting the rural fringe with the inner city, resulting in a continues landscape enabling a flow of vegetation, air, people and the horizon in and out of the city. This process is of importance due to the upgrading of larger urban entities and the linking of green spaces. Basic functions that support the urban environment and its population can be incorporated in these connections.

Applying the principles of urban agriculture and CPUL creates the potential to create structuring elements that support an integral development approach of communities. As part of a bottom-up development approach communities can be supported in the production of foods to start a development process that helps to overcome the poor urban conditions found in most informal settlements. As part of a integral development framework, urban agriculture can become a valuable aspect in the development of network of basic functions, such as water management and the creation of a spatial network that support the overall development of the participating community.

Links to urban development

To enable urban food production, the main resources need to be supplied. The provision of land, water and fertilizer can be provided through the integration of urban agriculture in the urban environment.

Water management

The productivity of urban agriculture is highly depended on the availability of sufficient water sources for the irrigation of productive grounds. One aspect of urban production is the potential to connect urban water management to the production of foods. The reuse of waste water is ideal to overcome the shortage of water in a growing number of areas worldwide. The available fresh water can therefore be used for domestic use, instead of the water consuming agriculture (Smit and Nasr, 1992).

Together with waste recycling, the reuse of water is seen as aspects of a multidimensional approach for the upgrading of the urban environments and of great importance in the reduction of the eco-footprint of cities. The more reuse of natural resources, the more efficient the urban metabolism. The reuse of water also competes with the inefficient movement of nutrients in the current production system. Organic nutrients in the waste water are reused inside the urban environment, providing a close by redistribution of the nutrients for agricultural use (Rose, 1999, Smit et al., 1996).

The need for the water management enables the potentials of developing water sensitive design values and the improvement of public space quality. The development of water line inside the community can be used to overcome flood risks. The upgrade of water systems also offers the potential of increased awareness of the environment and improved proud of the urban environment by the community.
Use of the open landscape will perform the main productive part of the network. The formation of agricultural spaces of different scales and with different production typologies, based on the green space’s characteristics. Next to production locations, the open spaces can be designed for social and recreational functions. The combination of both social and productive use of the landscape has the potential to strengthen the multifunctional use of the ground, potentially reducing the costs of the landscape maintenance (Drescher, 2001). The green/open spaces can be designed to perform at different scale levels. Urban parks can be designed as an element to perform as a public space for a large urban area. Urban parks in dense urban areas can facilitate multiple social functions and create recreational landscapes inside the city. As part of the network, urban parks can also facilitate urban production. Squares located inside the communities help to create different scales of public spaces and interaction. Inside communities it can enhance the social cohesion, similar to communal agricultural activities. The function of the spaces can differ from playground to communal production locations (Dubbelen, 2011). The planning of the green spaces inside cities can be based on the landscape features. Especially the use of marginalized and hazardous spaces form a great potential for the use as production location, in order to prevent habitation.

The development of productive lands can help structuring communities. The use of hazardous spaces as productive grounds can prevent future destruction caused by earthquakes, floodings, etc. The active recognition of food production locations is therefore an important part of the developments strategy.

Community empowerment

As can be seen in figure 3.4, the benefits of applying urban agriculture inside marginalized communities includes social inclusion and community building. These two forms of social capital can help in building up a community in the aftermath of natural or man-made disasters. Community based agriculture help restoring social structures inside the communities (Adam-Bradford et al., 2009). These community structures can be used for both the development of Community Based Organisations and the implementation of development strategy. The improved self-esteem due to the increased independence helps in the strengthening the awareness of the community of having a voice in the development process. Making them a valuable partner in the overall development process created around the upgrading of the community.

Another aspect of community support through the development of urban agriculture is the potential to integrate small food production along streets and public spaces, upgrading the public spaces to enhance the potentials of social interaction (Lattuca et al., 2005). Small public spaces such as playgrounds or pocket parks can enhance the social cohesion, such as communal agricultural activities (Dubbelen, 2011).
Conclusion - Use of urban agriculture in disaster relief

Urban agriculture has the potential to be used as a strategy for the development of communities or larger urban bodies. Also, urban agriculture can have a major influence on post-disaster relief and redevelopment.

The influence on the level of food security of the involved population is the major strategy for applying urban agriculture in emergency situations. The support of agricultural activities during the disaster relief phase creates the possibility to decrease food insecurity, creating a supply for fresh foods or medicinal herbs during the period its most necessary.

Second, the construction and maintenance of agricultural fields helps the people to restore dignity and self-respect. At the same time, the social aspect of community based agriculture helps to restore social structures (Adam-Bradford et al., 2009). On the longer term, the production can create livelihood for the effected population. Mainly in Internal Displaced Persons camps this issue can become of importance to create a broader developed community. The inclusion of waste re-use programs and reduced use of water and food resources make the communities less depending on external aid sources.

The integration of agricultural activities in post-disaster relief processes will help to enhance the resilience of the effected communities or cities. The development. The creation of local food sources and economic activities at the small scale will strengthen the resilience due to direct availability of foods after a disaster. Urban agriculture can also have a positive impact on the development of settlements (Adam-Bradford et al., 2009), therefore it is important to understand the possibilities of urban agriculture during the relief and development phase. Different steps can be seen in figure 3.8.

![Figure 3.8 Disaster management cycle with urban agriculture linkages (Adam-Bradford et al., 2009, p. 5)](image)

![Figure 3.9 Urban agriculture in Carrefour, Port-au-Prince (The Rooftop Garden, 2011)](image)
3.3 URBAN WEB STRUCTURE

For the development of urban structures, multiple theories have surfaced over time. One of the most common principles being developed in these theories is the formation of complexity. Among many other Jacobs, Koolhaas and Alexander believed that the creation of a complex system where multiple events can happen at the same time is the most lively, strong and resilient urban structure. Terms as congestion as part of a high availability of movement (Koolhaas, 1994) or the mix of people and activities on the streets (Jacobs, 1961) all contribute to the strength of the theory of the urban web. Written down by Salingaros, and inspired by many other, this theory describes the potentials of developing a complex system to plan and developed urban structures capable of expansion and adaption towards future changes of the system.

For this project the combination between two major theories is of main interest due to the connections between them and the relation to the topic of ecological and natural development. The first is the theory of the urban web by Nikos Salingaros. The second is the permaculture theory by Bill Mollison. Although at first sight the refer to completely different processes, both theories contain components that can be linked to each other and indicate possibilities for urban growth. Within this chapter the connections between the two theories is described.

The structure of the urban web described by Salingaros is build up out of three elements:

**Nodes;** are the spaces of human activities. These activities can range from working and living to natural and green spaces of activity such as parks.

**Connections;** are the lines, streets or pathways connecting the nodes. The connections are not necessarily a straight line between the nodes, in order to enable multiple connections, the lines can be curved or irregular.

**Hierarchy;** of the connections created will help in the establishment of an organized web of node and connections. If possible the web can self assign the hierarchy of the connections. The hierarchy is visible in the form of different levels of scales the connections are developed for.

The combination of these elements will form a network of interlinked spaces of human activity and movement. The strength of this strategy is created during the development of multiple connections between the nodes. As can be seen in figure 3.6 connections between nodes can be generated in a straight line creating only a single possibility for the connection between the nodes. Another option is the development of curved lines, creation the possibility for multiple connections between the nodes.
The nodes introduced in the theory are spaces inside the web structure that attract people for some reason. Therefore it is of great importance to understand that the nodes are not just buildings or parks. Also small urban spaces of interaction or facilities that support street life can function as nodes. The connections between the nodes are seen as spatial links, meaning that the connections are not necessarily visual link. Although the development of clear sight lines and visual orientation points are of great importance to the possibility to orient inside urban places, they are less essential for the development of the urban web structure.

To understand the potential of the urban web structure it is important to understand the need for complexity of the urban environment. The higher the level of connections and thereby the level of complexity, the higher the potential functioning of the urban web. The high level of connections may look unorganized and impossible to understand, the more organized urban spaces, e.g. Modernistic urban plans, are lacking the high level of connectivity and complexity of relations, thereby the potential functioning of the urban structure. Well connected and ordered urban structures can look irregular for above (Gehl, 2011).

One of the principles behind the theory of the urban web can be described as the creation of connections between different spaces of human activity to enable the cooperation between these activities and spaces. These activities support the development of livelihood and enable urban life.

During the development of the urban web structure, the existing urban system will transform from an un-organized into a organized system. During the growth of the urban web structure, multiple new connections and nodes can be introduced into the network. Over time these additions will become part of the web structure and influence the performance of the overall network (Salingaros, 2005).

The addition of nodes and connections into the web structure will, at a certain point, form a critical mass for the web structure to function on its own. The number of connections between a large number of nodes will support the movement of goods and people in such a way that the network in itself is self-sustaining in its performance. The urban web structure is able to self-organize itself (Salingaros, 2005).

The addition of the urban web structure in un-organized settlements will increase the potentiality of development. The gradual process of development of the urban web structure can thereby contribute to a gradual development of an urban area and transform the area of intervention into a urban web structure that support the complexity and connectivity of the urban web structure, thereby supporting the use of the environment and enables urban and human development. The structure of the web can be created through hierarchy between nodes and connections. Depending on the functions in the web, centres can be enabled to form the web structures that support the structuring of informal settlements.

To enable the performance of the urban web structure it is of great importance to create links between different nodes inside and outside the project area. Increasing the number of links will increase the potential output of the developments, especially in insufficient connected settlements this can contribute to the development.

Fig. 3.11 Differences in urban structures and the evolution of the urban web. (Salingaros, 2005)
3.4 PERMACULTURE

"Permaculture (permanent agriculture) is the conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems. It is the harmonious integration of landscape, and people providing their food, energy, shelter and other material and nonmaterial needs in a sustainable way (Mollison, 1988, ix)."

This theory focuses on the creation of cooperation and cohesion between the parts all needed for a sustainable and ecological strong form of agriculture. By not focusing on only one part of the equation or needs for development, but implementing other parts into the development process will increase the potentials of the development. Working together instead of against nature is of great importance in this theory, creating a link to the development of an ecological system to strengthen the existing urban conditions found in most places. Although the core principles of this theory are developed for the use in the agriculture, some of these principles are also applicable in the development processes of urban areas.

The permaculture theory can be applied in urban development approaches to state the sustainability goals of the projects. The cooperation and mutual benefits of these cooperations strengthens the outcome of projects. Integrated in the whole development permaculture can support an overall sustainable lifestyle.

Some of the principles applied in permaculture that can also be applied in urban development, especially in combination with the urban web structure are (Mollison, 1988, 35):

**Principle of cooperation:** “Cooperation not competition is the very basis of future survival and of existing life system.”

**Principle of cyclic opportunity:** “Every cyclic event increases the opportunity for yield. To increase cycling is to increase yield.”

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

The permaculture theory focuses on the development of a stable and ecological form of agriculture, the principles can be transformed to the world of urban development. Once the daily urban processes undertaken inside the urban system are compared to natural processes, a possible comparison comes to light.

It is the functioning of the overall network of smaller parts that formulate the output of the developed system. In case of natural networks these are foods, in the case of urban networks these are the different functions that together support daily life. The cooperation between the multiple functions that are being developed or are present inside the urban area will support a combined performance of these functions. By cooperating, these functions will gain a higher yield or better performance. While overtime the number of functions that are cooperating expand, also the possible outcome can increase, during each cycle of development the output can increase.

Same as in the agricultural aspects of permaculture, the number of connections between the urban functions form stability. If the functions are cooperating in a successful way, the more resilient the overall system is to external disturbances.
3.5 HYPOTHESIS

As described in the problem statement, the poor urban conditions that are found in informal or marginalized settlements all over the world decrease the potential participation of the urban poor living in these communities. To overcome these conditions many governments have worked on the development of basic services to enable a gradual growth of the community thereby starting a process ‘equal development of all its citizens without endangering the environment or living conditions of people, now and in the future’ (Girardet, 2000). The missing aspect in these developments is the empowerment of the community itself. The process of developing for them does not involve them into the planning process creating conditions that the community does not support developments.

Another approach towards the development of communities is a bottom-up approach that supports and empowers the community in the developments of their needs and wishes. These demand-driven developments can satisfy the basic needs of communities. When included into a larger development framework, the stand-alone developments in and by communities can be used for the build up larger urban areas. The combined focus of the local development framework combines these small-scale developments with the support of local governance, sectorial developments, and private sector growth, see figure 3.5.

It is this combined focus that makes the local development framework suitable for the development of a community action plan (CAP) developed during a participatory planning process that combines the needs and wishes of the community and the knowledge of experts on different sectors, such as urban development.

Linking of functions

An important part of the CAP development of clear structures that enable the development of urban environment. The aspects of the urban web theory and permaculture focusing on connections and cooperation between different part of urban development can enable the development of urban structures that support an integral development of marginalized communities.

The first step is the support of the community by the development of the basic needs. The need for the development of the basic urban functions is highlighted by the presence of these goals in the Millennium Development Goals (MDGs), set by the United Nations (United Nations, 2010). These functions do support the quality of life and are therefore of great importance to be developed. The addition of urban agriculture in this spectrum can help the formation of more closed metabolism inside the settlement that is being developed. By linking these different functions, the output of one function can become the input for another function. Through these connections, environmental strong technologies can be applied to increase the sustainability of the settlement and the decrease the demand on external (natural) resources. Urban agriculture can be used as the extra addition in this network of function to generate direct feedback to the community in the form of foods for the community. The output of the different functions can become the input materials for agriculture, or at least two of the main elements, water and fertilizer.
Development of urban structure
In order to enable the development of an urban area and to create spaces for urban agriculture to be implemented in the community a spatial strategy will need to be developed. Based on the theory of Salingaros (2005) networks of urban spaces, including productive lands, the third element, can be build up. The complex cooperation between the different spaces of human activity reflect on the principles of the permaculture movement, where the more complex the cooperation between different parts results in a higher yield of production.

The creation of urban network increases the potentiality to further incorporate urban agriculture and ecological technologies inside the settlement. Through the development of basic elements that together will form the urban network, the different basic functions can also spatially be linked. This step in the development process can result in a high level of cooperation between the different functions. This can result in the creation of an integral development framework that incorporates the different functions and spaces to form a network that supports the human and urban development of the community. The social, economic, and environmental benefits urban agriculture has to offer become part of this development offer the opportunity to strengthen the development process to include ecological and sustainable technologies in the bottom-up development.

The formation of an integral development approach can be the first step towards sustainable development of informal and marginalized settlements. Through a system of links and cooperation between both essential urban functions and urban spaces communities can spatially be build up. The involvement of the community in the process of planning, design and implementation as part of the local development framework will strengthen the development of these links.

Empowerment of the community as part of the local development framework is just a first step towards the human, social, and economic development of the most vulnerable groups. The development of these groups can be the start of an overall development of the society in developing countries.

The creation of a strategy that incorporates all these elements into one planning framework can be used as a first step towards an upwards development of the urban poor by the creation of a supportive urban landscape that incorporates the basic needs of communities into the urban landscape and enable a sustainable development and use of that landscape.

The linking of system enables the cooperation between functions, thereby offering opportunities for urban agriculture to be integrated in the urban environment. The reuse of present urban resources supports the increased yield generated in the settlement.
The theories researched in the theoretical framework and the formulation of the hypothesis need to be translated into a development strategy. During several stages a framework for the participation of the community in the development process is formulated. The process of participatory approach is then translated the formation of a Community Action Plan to guide the spatial transformation and upgrading of the involved community. The formation of functional and spatial links forms the spatial conditions for development of the community and enables urban food production to overcome the most urgent needs.
4. DEVELOPMENT STRATEGY

4.1 LOCAL DEVELOPMENT FRAMEWORK
4.2 PARTICIPATORY PLANNING
4.3.1 PROJECT START
4.3.2 PROJECT GOALS
4.3.3 ANALYSIS FRAMEWORK
4.3.4 VISION DEVELOPMENT
4.3.4A LINKING OF FUNCTIONS
4.3.4B FORMATION OF URBAN WEB STRUCTURE
4.3.5 IMPLEMENTATION OF VISION
4.1 LOCAL DEVELOPMENT FRAMEWORK

An important element in the development process of developing countries is the low level of effectiveness of the central government and general sectorial developments on the scale of neighbourhoods and settlements. Mainly the urban poor are not integrated in the development process and therefore excluded from the essential urban developments. The post-disaster situation of Haiti offers the opportunity to restart the development processes. The weak state of the Haitian government is capable of offering the potentials of developments to the (urban) poor population. The marginalized communities are disconnected from the planning perspective. The approach to start the development process at the small scale to work bottom-up needs to overcome these situation. A spatial instead of sectorial approach forms a logic platform for multi-sectorial developments that reinforce settlements that houses the urban poor. Next to that, it also enables a further integration of the community based developments, supported by most NGOs (Helling et al., 2005).

As part of a local development framework (LDF) (Binswanger-Mkhize et al., 2010) that focuses on the combined development of public services, empowerment of communities and the strengthening of local governments, participatory planning can be used for the development of a Community Action Plan (CAP). The CAP is a development vision for the specific project area that is created during the cooperation between professionals, Community Based Organisations (CBO) and other stakeholders. The participation of all stakeholders is of great importance to enable an integral development of the settlement. The integration of the CAP into the perspectives of a local development framework enriches the process of development of the main goals.

It is the combined recognition of the need for urban development in informal settlements and the increasing empowerment of the urban poor that strengthens the network of combined functions. The support by local governance and technical support on specific sectorial issues by the national government increases the potentials of implementation of this strategy. If the settlements can be upgraded according to the needs of the community in combination with accountability of local governments this development framework can function as the first step towards an overall redevelopment of urban environment in Haiti. It is not the central government that facilitates the development, by merely support the bottom-up development process started at the communities. Through several layers of governmental bodies and agencies the central government can influence the development process, but only as one of the partners in the whole process.

The strategic visioning incorporated in this planning process forms the link between all the stakeholder. The combined envisioning of the CBO in cooperation with experts in the different sectors that involved in the development of the community.

![Fig. 4.1 Local development framework (Helling et al., 2005,)]
In order to overcome the large proportion of donor-driven developments presently active involved in the development of informal settlements a new planning framework need to be introduced. The focus of the development process needs to shift towards the visioning and long-term planning to enable sustainable development of these projects. One of the main aspects in the development of such a development focus is the inclusion of the local communities inside the plan development.

The inclusion of the urban poor, most often neglected in the planning process, helps in capacity building and social capital. The combination of the local knowledge on the urban environment and social aspects that are of importance in the development process need to be valued. Only top-down planning of facilities will not generate integral plans on the smallest scale. The purely sectorial approach will not create beneficial links between functions.

In order to generate integral development visions a consensus between different stakeholders need to be developed. This process will result in a integral development vision for the involved community. This vision recognizes and values local needs and urgencies and integrates them with the development of multiple basic facilities.

The process of creating a development in cooperation with all stakeholders can be used as a part of the local development framework. The development vision is the result of combined visions of the stakeholders on the development of the involved community and should be used to represent the potential developments to upgrade the settlements.

Aim of the development of a vision in cooperation to all stakeholders involved is to create a consensus between them and enable an active cooperation. This cooperation should lead to an improved outcome of the project. Strengthening the urban environment of the urban poor, thereby supporting a bottom-up development of a developing city.
4.2 PARTICIPATORY PLANNING

The community action plan contains the development vision for the involved community. The cooperation between all the stakeholders will result in the creation of the CAP.

Formulating and implementing a CAP is the result of a process of multiple steps that will help in structuring both the development vision and the implementation. These steps can be described as following (Fisher, 2001, 32-33):

1. Project start
2. Creation partnerships
3. Stating the project goals
4. Analysis of the project area
5. Development of vision and implementation plan
6. Implementation of vision and follow-up

One most important comment on the scheme of the participatory planning, is the lay out as a linear process. In reality, the process is not managed as a linear process. Due to the complexity of this process, the steps can overlap, converge, diverge, concur, and interact (Fisher, 2001). It can be seen as necessary to redo or skip one or more steps in the process to strengthen the outcome. It is possible to work in different time frames depending on the urgency and easiness of development and implementation of the included developments.
As part of the local development framework, the six steps of participatory planning are used to build up the Community Action Plan. Following these steps lead up to the formation of a coherent vision for the development of the settlement.

**Project Start**
Local development projects can be started for different reasons, ranging from natural or man-made disasters to intolerable problems. The presence of NGO’s in the post-disaster situation are one of the organisations that can trigger the start of a project. This strategy focuses on using the created momentum after a disaster to overcome the poor state of urban development in informal settlements. The envisioning of this strategy on the implementation of the basic urban functions is part of a strategic planning process.

**Haiti situation**
In the decades leading up to the earthquake, the institutional organisations in Haiti have been unable to develop a framework for the development of the country and its urban areas. The weak governmental structure present in Haiti was unable to create any form of planning perspectives in the aftermath of the earthquake. All the renewed institutional, functional, and financial support in Haiti offers the opportunity to overcome the weak ex-ante situation. It can be seen a tabla rasa for the redevelopment of Haiti.

The support of major institutional knowledge, mainly provided by the United Nations, can help the national government to recreate its planning frameworks. The decentralization of the planning and implementation is one of these approaches already advocated by the UN Habitat in order to enable the development of Metropolitan Port-au-Prince (Forsman, 2010).

The lack of any form of mechanism for coping with disasters in the densely populated area of Port-au-Prince is just one of the examples of the lack of planning perspectives by the Haitian governments. In combination with the distortion of the urgent needs and long-term developments, the need for an exceptional planning framework and a shift in the planning perspective come to light.

Using the Local development Framework to rebuild the city from the bottom upwards by the regeneration of neighbourhoods as the main objective. The inclusion of the different communities affected by the destruction caused by the earthquake is another main objective to be increased.

The strategic planning process creates an integral vision that enable the development and transformation of the involved settlement into a more inclusive and participative part of the larger urban fabric. An NGO in itself is not capable of developing and implementing an integral development vision for the community, therefore it is important to include different parties, stakeholders, that have a curtain amount of interest in the development of the settlement into the process, making it a participatory planning process.

The process of building up communities is therefore best included into the development of a local development framework to start a integral and inclusive development process that strengthens the local development, not just of the local community, but also it surroundings.

**4.3.1 Project Start Up**

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The process of building up communities is therefore best included into the development of a local development framework to start an integral and inclusive development process that strengthens the local development, not just of the local community, but also its surroundings.
4.3.2 STAKEHOLDERS

Creation partnerships; is the search and engagement of local participants in the development process. The mobilisation of stakeholders is of great importance for the development of the project. The relevant stakeholders that should be mobilized to included in the participatory planning process includes (UNCHS Habitat, 2001, 6)

- Those who are affected by, or significantly affect, a priority issue
- Those who possess information, resources, and expertise needed for strategy formulation and implementation; and
- Those who control implementation instruments

The importance of including all the possible stakeholders in the process will lead to a better understanding of the complexity and needs of development and create support for the final implementation of the development vision and CAP. During this phase an Community Based Organisation (CBO) needs be started if not present, after which it can become an important partner in the development process.

The representation of the community is just one of the partners in the development team that needs to be constructed. Other stakeholders are local governments e.g. chiefs. The involvement of governance is required for the validation of developments and to frame the local developments in more complex systems working on a larger urban scale.

Depending on the focus of the project team, the focus of the project goals will be developed. The focus on one or multiple most urgent needs or project goals can shift the importance of one or more stakeholders (Albrechts, 2006). This shift in focus can result in a shift of the development focus. In this project, the development and implementation of environmental strong technologies and the food security are two major fields of focus. By including major stakeholders for the development of the two goals the project visioning can have an increased focus on these two goals.

Fig. 4.3 Stakeholders involved
Stating the project goals; will define the focus of the Participatory planning process and its intended outcome. Using a vision as tools for the formulation of the goals of the strategic planning results in the definition of clear goals for the project to focus on. In this strategy the focus lies on the development of the basic urban facilities and function that support the overall development of a settlement and the improvement of the quality of life. The development of these functions is based on the principles of sustainable urban development. In cooperation to the empowerment of the community, a long term development can be created. A major benefit of this strategy and the use of a participatory planning process is the development of social capitol inside the involved community. The project goals can for instance be stated as vision of what should be developed after the project is finished. This vision can be created by the different stakeholders separately after which it can be combined into a transformed into a project statement or development vision. It will help to formulate clear project goals that can easily be evaluated afterwards.

3A General goals
As part of this overall development process, a major aspect of the development focus should aim at the creation of sustainable urban settlements. The inclusion of urban agriculture is one of the main aspects in this. As can be seen in figure 4.4, urban agriculture has the potentiality to be linked to all the basic urban functions. The creation of these links will strengthen the performance of the urban environment, thereby creating two main benefits:

- **Inclusion of environmentally strong technologies**, increase the settlements sustainability through the use and reuse of the available resources inside the settlement. The links creating between the functions do support these processes, thereby reducing the need for external resources and the improved of the settlements eco-footprint.
- **Urban greening**, is of importance due to the support it can generate to the process of creating better livable urban settlements. As advocated in chapter 3.2 urban agriculture can have major benefits on the quality of the urban environment, such as filtration of air and removal of pollutants.

3B Specific goals
Depending on the existing conditions of the settlement, specific goals need to included in the development process. These goals can range from the creation of public spaces to support daily processes in the community to the development of basic infrastructure such as electricity networks or canals. These goals need to be appointed by the local community. Most often these are the perceived problems of the settlement and unclear to external observers.
4.3.4 SETTLEMENT ANALYSIS

Analysis of the project area is the search for the problems, both perceived and real inside the project area. During, for instance, a series of workshops the different stakeholders can state their vision on the current urban conditions of the involved settlement. The different stakeholders have the capability of prioritizing the different problems. All the stakeholders have priorities in the development of certain goals, therefore it is of great importance to include all stakeholders in the process. The combined analyse the problems will strengthen the outcome of this stage, thereby enabling a stronger outcome of the whole project.

Once all the information is gathered it is the interpretation and transformation of the data into project objectives that state the outcome that wants to be pursued until the end of the project. This phase can result into a clear map or other form of documentation of the recommended problems that need to be solved. In combination with the intended goals of the project, development of basic facilities and integration of urban agriculture, this document can state clear spatial interventions that need to be developed for a successful integration of the project into the settlement. In combination with a list of priorities these interventions be ranked in order of intended implementation.

The involvement of the community can help in finding specific problems in the settlements layout that are not seen from the outside. The problem finding together with the stakeholders can be conducted by using the following steps (Fisher, 2001, 60)

1. What is the real problem?
2. Why is it a problem? Or, what is causing the problem?
3. Why should the problem be solved?
4. When and where is it a problem?
5. Whose problem is it? Also useful in identifying a potential stakeholders.
6. What would happen if the problem wasn’t solved?
7. Once again, What is the problem?

The spatial element of this strategy needs to be analysed by researching the existing spatial conditions. Most important information needed in order to be able to formulate spatial developments these aspects need to be analysed:

- Settlements context
- Demography/ community profile
- Typography
- Open and green spaces
- Water networks
- Water distribution points
- Road network
- Settlements typology
- Community facilities

To finish the analysis phase a SWOT analysis can be conducted to formulate the most urgent needs that can be written down in a analytical output.
Now that the goals of the project are known and existing urban conditions have been explored it is time to start working on the development vision for the involved community. Through a process during which professionals will develop this plan in cooperation with the other stakeholders the community action plan will be formed as a document to enable the development of the settlement and its community.

The development of the vision consists out four steps. These steps form the general process for the development of the vision. Depending on the local conditions, the exact application of these steps can differ.

1. The first step in the process is the linking of the different functions that need to be developed inside the community to support the human and social development. The higher the level of cooperation between the different functions, the higher the complexity of the network, the higher the networks yield (Mollison, 1988). One important aspect of the linking of functions is the enabling of agricultural production through he use and reuse of local resources.

2. After the creation of functional networks, the urban web structure need to be developed to enable spatial interventions inside the settlement. The generation of the web structure will be based on the principles introduced by Salingaros (2005). The development of multiple well interlinked spaces of human activities enhances the settlements structure, thereby increasing the potentialities of use.

3. Once these steps are completed, it is of great importance to check the proposed developments with the other stakeholders. This is also the opportunity to receive feedback from the stakeholders, thereby strengthening the vision.

4. After these steps the Community Action Plan can be detailed to finish the planning phase of this project.

The outcome of this phase is a clear spatial framework that shows the location of interventions planned and connections created in the settlement. The different aspects of the functions that are part of this strategy are located in the settlement and are both functionally and spatially connected to each other. The elements of the network, explained after this step, are situated in the existing situation.

In negotiation between the stakeholders the vision can be worked out into a detailed plan of interventions and action in the spatial configuration of the settlement, thereby creating the potentiality to increase the metabolism of the community and decrease the dependency on external sources to support the agricultural production inside the community.

The general goal of the vision is to enable possible production of foods. The main needs for food production, water, fertilizer and land need to be integrated in the development vision. Without these three needs production will not be possible. The availability water and fertilizer can be enabled through the functional links in step 1, the land provision is part of step 2.
4.3.5A LINKING OF FUNCTIONS

"... it is a philosophy of working with rather then against nature; of protracted and thoughtless action; of looking at systems and people in all their functions, rather then asking only one yield of them; and allowing systems to demonstrate their own evolutions." (Mollison, 1988, 3)

The first step in development of a vision for the community is the linking different parts of development programs to each other will influence the performance of the separate functions creating a better performing network. The essence of creating networks of functions that are working together can be found in many different fields of expertise that can be linked to this strategy, strengthening its potential. Same as the principles of cooperation within the permaculture theory (Mollison, 1988) and the theory of the urban web (Salingaros, 1998), this strategy also incorporates the development of a web between the different functions and programs it is working with. During multiple stages of development the separate basic functions that need to be developed to support the livelihood and develop a higher quality of life inside the involved settlement will be connected on functional and spatial levels to generate a network of urban spaces which together will form, at start, a settlement-wide network.

As part of the Local Development Framework, the creation of functional links has the potential to outreach the single settlement involved in this project. The support local governance can aim at the creation of an inclusive network among multiple settlements to enhance the performance of the networks in its entire area.

In order to enable a sustainable urban growth and development of informal settlements into inclusive urban communities, the availability of essential urban functions of vital essence. The lack of basic functions such as sanitation and infrastructure forms a major constraint on the potentials of informal settlements. Each of the developments has an own program and by linking these programs, the functions can be linked to create a synergy between them. The development of these functions in close cooperation to the community empowers that community through the increased control over their settlement and its facilities. It is important to actively involve the community in this phase. By involving them in the development process, links can be tested and the community can be educated in how to use the developments in the right way to decrease the potentials of failure.

Although urban agriculture is not one of the major needs in urban development it is integrated in the development process because of the potential benefits it has on the involved community. The valuable addition of urban agriculture to the development program also creates opportunities produce an output that directly flows back into the community. The return of foods and other products into the community creates a closed circle of products and nutrients. The local metabolism will partly be closed, decreasing the dependency on external sources.

Fig. 4.3 Separate functions can create an interlinked program of development.
As explained before, the linking of the different functions that need to be developed in order to support the development of the settlement and its community can have multiple benefits on the use and functioning of these functions. This stage of the development process focuses on the development of these links.

Figure 4.4 shows basic diagram of how the multiple essential basic functions can be linked through individual developments. The network created enables the use and reuse of essential resources inside the community. The system creates enables a closed metabolism inside the community through the production of foods for the community using recycled waste water and an integral waste composting program. When applied inside settlements, the configuration of the different connections can differ, depending on the local characteristics. Agricultural production possibilities is depending on three aspects that can be included in the development of this strategy; soil, fertilizer, and water. The first one will be developed as part of the urban web development in the next step. The last two are part of the linking of functions.

The links that are created start the process of the formation of basic elements that will be integrated into the spatial developments and the creation of the urban web structure. By doing this, the essential functional and spatial links will be created to support the community. As can be seen, three spatial framework are created, all consisting out of multiple parts of the functional programs.

The aim of connection the different functions together is to enable the provision of resources need for urban production. The two resources that can be provided through the integration of the links provided in the diagram are:

1. Waste management
The waste management program aims at the integration into the other developments in order to enable the collection and composting of the organic waste into compost that can be used as soil fertilizer on the productive grounds. The process of waste collection is integrated into the housing development and the composting process will be an integral part of the productive locations.

2. Water management
Other important connections that need to be developed are the integration of water management in the development of the road network and the housing developments. These steps are further worked out on page 68/69.
Fig. 4.4 Overview of connections between the separate functions as part of the development strategy.
WATER MANAGEMENT

The provision of water for the irrigation of productive grounds is one of the three main pillars for successful (urban) food production. In order to provide water for production a system of flows inside the settlement will be created. These flows will be incorporated in the different elements of the urban network that will be created in the next step of the development process.

Water supply
Households use two sort of water—potable and non-potable—in their daily routine. The potable water will be used for the washing of hands and food and drinking in general and will be supplied through communal distribution points implemented in the community. The non-potable water for i.e. general cleaning will be collected through a system of rain water harvesting and storage. The provision of dry compost toilets reduced the demand for non-potable.

Grey water
After domestic use of the potable water, the grey water will be put through a series of natural filters to purify the water and prepare it for the use as irrigation water. The first step is the on-site purification of grey water inside a grey water garden. This garden will be incorporated into the housing development. The size of the grey water gardens will be about 0.5 to 2.5 m² per person is prescribed (UNEP and TU Delft, 2008).

On-site purification reduces the demand for large scale filtration possibilities and can be included in the housing design. The grey water gardens are used for first filtration of the grey water leaving the households and the from the hand washing facilities that are part of the toilets.

The waste water gardens (Rose, 1999) introduced are will be used as first filtration of the grey water. Through the creation of a linear wetland system, plants such as reed beds will filter the water.

Filtration constructed wetland
Next step in the filtration of grey water are two stages of constructed wetlands. In the form of horizontal subsurface flow constructed wetland, that reduces the possibilities for mosquitoes to breed, pollutants, organic material and particles will be removed from the grey water (Tilley et al., 2008, UNEP and TU Delft, 2008, U.S. EPARD, 1988). The first form of wetland will be introduced in the urban environment in the form of green-blue lines. The input of these lines comes out of the collective grey water gardens and from swales that are created as an integral part of infrastructure developments. These lines will connect both inputs to the constructed wetlands that form the intermediate towards the canals. These second wetlands are developed as an extra filtration system and to function as extra temporary storage capacity during heavy rainfall.

Canals for conveyance
An important part of the water management system is the conveyance of water towards the production locations. The waterlines will be constructed so that water can be, partly, retained. This will result in a reduction of the flow velocity reducing the potential erosion and creating possibilities for the implementation of plants. These plants can function as another filtration system or as part of the food production system.

Use of grey water for irrigation
Last stage in the use and reuse of water. The use of grey water for the irrigation of productive grounds is a common practice in whole the world and is seen as one of the main benefits of urban agriculture. The close relation between urban water sources and the high availability of grey water and potential use of a valuable resource (Rose, 1999).
**WATER MANAGEMENT**

**Potable water**
- Drinking
- Food washing
- Cooking
- Hand washing

**Sanitation**
- Eco san
dry compost toilets

**Grey water gardens**
- Internal grey water purification

**Grey water**

**Green-blue filtration lines**

**WATER MANAGEMENT**

**Potable water supply**
- Central points
- Delivery by
  - Truck
  - Well

**Non-Potable water**
- General cleaning

**Streets**
- Drainage through swales

**Non-Potable water**
- Washing facilities

**Canals**
- 2nd filtration lines

**Production locations**
- Use for irrigation

**Green-blue filtration lines**

**Constructed wetlands**
4.3.5B NETWORK FORMATION

Second step, after the formation of the network, is the definition and formation of spatial elements that together will form the urban web structure that supports the performance of the settlement.

The functional links created before will be used as starting points in the formation of spatial elements in the form of nodes and connections that together will form an urban web of developments. As pointed out by i.e. Salingaros, the creation of an urban web increase the potential yield or performance of the strategic development.

The development of the complexity in the web increases the amount of connections which can be created. The more connections between functions, nodes, the higher the level of cooperation between the functions is, the higher the outcome, or yield in the permaculture, of the web will be. The development of the urban web not only develops the possibility to create multiple links between different functions, it also increase the possibility to develop other functions that can benefit from the developed complexity, thereby strengthening the level of developments. This strategy can thereby trigger an upward cycle of development.

The level of development is not bound to the borders of the involved community, but potentially can expand across a larger urban area, integrating multiple settlements into the developed urban web, further increasing its complexity, connectivity and potential.

As said before, the creation of a spatial network of linked developments is based on the theory of the urban web (Salingaros, 1998). In this theory the urban web exists out of three components, namely Nodes, connections and hierarchy. These principles are also applicable for this strategy.

The development of the urban web using the introduced components will supply the basic infrastructure required for urban livelihood and urban production of foods. The development of the basic infrastructure creates the conditions for further development of the strategy by the involved persons themselves, while at the same time it is made sure that the essential components are developed to support the livelihood. The strategy of only developing the essential components to enable further development is more often applied in similar project on both the urban and architectural scale (elemental, 2012).

The development of an urban web exists out of six main elements:

- Productive spaces
- Housing development
- Socio-economic facilities
- Road network
- Slow infrastructure networks
- Water networks

Fig. 4.6 Evolution of spatial network over time. Multiple nodes form the network
Disconnection between development sector.

Creating synergy between stakeholders and functions offers potential for new developments.

Increasing the connections increase the yield

Fig. 4.7 Enabling connection between spaces and functions enables beneficial functioning of the network.
1. Productive spaces

To ensure the creation of production possibilities, productive spaces will be developed as an integral part of the network. Alongside the production of food the production also link the water management by providing open and green spaces that can be used as part of the process of filtration of grey and black water produced in the households and community washing facilities or for (temporary) storage locations of rainwater in the case of heavy rainfall, reducing the required capacity of the drainage system.

With production of foods as its main function, the productive spaces can also be used to produce input materials for the production process. The production of fertilizer and compost can both be linked to the development of sanitation, creating a direct flow of input materials in the community itself. The production of compost and fertilizer will therefore be integrated into the development of the production facilities.

2. Housing developments

Essential in the development of informal settlements is organized housing development. Although this strategy does not focus on the development of buildings itself, it does support it.

The development of the essential elements of the housing plans will therefore be incorporated into the planning of the settlement. The provision of the essential elements will create the conditions for development of the housing itself.

The integration of sanitation and household water management into the housing development is the first step in creating organized housing developments. These functions will therefore be developed as part of the housing plans without the development of the dwellings themselves.

3. Socio-economic facilities

As part of the network that supports the local community and strengthens the social cohesion inside the community, socio-economic facilities will be created on strategic locations inside the network. Depending on the location inside the network the function of these facilities can differ. These nodes can for instance be used for the creation of communal washing facilities or as spaces that can be used by the community to increase the social cohesion, i.e. sport fields or community centres.

For the development of these facilities a high level of spatial connectivity is recommended to increase the reach and possible use of these facilities.
4. Infrastructure

The development of an infrastructure network as part of the development strategy ensures the creation of spatial links to support movement between the nodes. Along the development of roads, the infrastructure connections can also integrate drainage (water management) and utility lines, such as electricity lines, into the development.

5. Slow infrastructure

As part of the network of connections that connect the nodes, the creation of slow infrastructure lines is of importance to create a hierarchy in the network of connections. These soft infrastructure connections focus on the creation of public spaces that can be used by slow traffic and will form the connection between the hard infrastructure and the dwellings. This in-between component forms a link between the privacy of home and the public of the roads. The slow character of these lines makes them ideal for the integration of food production and water management facilities. In coordination to the CPUL theory (Viljoen et al., 2005), these slow spaces are ideal for use as linear production locations, for instance trees that at the same time provide shade.

The continuous aspect of the spaces and the connections to other components creates the potential to integrate grey water management in these lines as a link between the household (production) and water streams (transport). Using green filtration technologies, such as constructed wetlands, contribute to the process of urban greening and beautification and will help creating a more positive image of the community.

6. Water lines

The construction of water lines as part of the development strategy will ensure the connection of the water management system to other nodes. The characteristics of the waterlines depend on the landscape and capacity of the water lines that needs to be developed to support the water management.
The addition of production facilities to the development spectrum is one of the main goals of this research, therefore the production facilities are seen as an integral part of the development and facility multiple functions of the network in its locations. The production locations can be used, next to the production of foods, for the

- production of input materials (compost)
- Wetland structure for filtration

In this model, the production function will be selected based on the location of the production site inside the network of development. The development of multiple agricultural locations creates the possibility to integrate all functions of the production circle into the production locations, decreasing the need for external resources and materials.

Depending on the characteristics of the production locations itself the production typology can be selected. Based on project all over the world concerning urban agriculture on different scales, the production typology can be classified under:

- Horticulture
- Aquaculture
- Aquaponics
- Livestock
- Forestry

These typologies have their own production capacity which will be calculated after the selection of possible products that can be produced to review the possible benefits the production location can offer for the local community.
As part of the production facilities and to support the sanitation and waste management programs, composting of both human and organic waste will be integrated into the program. The cooperation between the two functions will result into the direct availability of fresh and nutrient compost at the production locations.

Using dry composting toilets the human waste, faeces and urine, can be collected, transported and composting. At the end of the process both waste materials become input for agricultural use in the form of compost or nutrient soil in the case of faeces and fertilizer in the case of urine. For both flows separate systems are developed in both the developed and developing countries to make benefit of the high availability of nutrients.

**Composting of faeces**

After the collection of the faeces will be composted on specific for the task design area on the production location. Using a two stage strategy, the faeces will be turned into nutrient rich soil and compost.

The first stage is the composting in inside a composting structure. The faeces is dumped in large piles retained by removable wooden walls. After two the walls will be removed, revealing a pile of compacted faeces. The second stage is the creation of windrows in the open air, leaving the faeces to further compost for six months. After these two stages, the harmful bacteria are removed out of the compost, leaving nutrient rich soil behind (Kramer et al., 2011, Tilley et al., 2008).

The collection and temporary storage of both faeces and urine will be conducted in the compartment underneath the toilet seat. In this compartment containers or buckets for the collection of both materials need to be placed.

After the collection, the urine will be stored in airtied container to prevent the odours to come out. After a period of minimal a month, the urine is ready to be used as fertilizer of crops (Richert et al., 2010, Tilley et al., 2008).
Urine composting
The use of urine as fertiliser during the horticulture production process replaces the use of chemical fertilisers, creating an eco-friendlier production process. (Richert et al., 2010, Tilley et al., 2008). The presence of large amounts of chemicals and nutrients in urine make urine a suitable fertilizer, especially in areas where there is a close connection between urine collection points and the use as fertilizer. The application of urine as fertilizer is in general accepted all over the world and is a proved concept of fertilization of productive grounds.

When used for non-private production, it is advised to store the urine for a minimum period of six months. During these months harmful pathogens will be removed (Tilley et al., 2008).

The storage of urine on the production locations can be created in the form of airtight containers that are sealed during the six month period of storage. After these six months, the urine can be transported in jerrycans. If not all the urine is used on the own production locations, it can become a source of income for the community.

The application of compost and fertilizer
The application of composted faeces is fairly simple. Due to the dehydration, the faeces forms a dry and crumble material that can be mixed with the soil of the production facilities.

In combination with the stored urine the faeces is a valuable substitute for chemical fertilizers.

The application of urine as fertilizer is best practiced in three different ways:

- Mixed undiluted into soil before planting;
- Poured into furrows sufficiently away from plant roots and covered immediately (once or twice during the growing season); and
- Diluted several times and used frequently (twice weekly) poured around plants (Tilley et al., 2008).

It is important to not over do the amount of fertilizers, otherwise it can pollute the soil, reversing the effects.
The proposal for the development of an overall housing development scheme consists out of three main element, additional to the planning of housing:

- **Dry compost toilets**
- **Household water management**
- **Waste management program**

As can be seen in figure 6.3, these three additional functions form an important part in the creation of the functional network between the different functions proposed.

The importance of these functions is the development of these basic facilities to improve the health conditions of the involved inhabitants.

The development of the housing plots is based on the principle of providing the basic elements. By developing only the basic elements thereby creating the outlines of the buildings will help the involved household by the provision of the most important and technical difficult elements. The development of the housing itself is the owner responsibility. This strategy creates a better provision of the basic functions for the different households, while at the same time these functions are also incorporated into the larger network of development.

**Incorporated sanitation**

For the development of settlements in post-disaster situations, the development of proper and sufficient sanitation is of great importance and seen as one of the first goals to be developed. As part of the importance of sanitation, there are some clear guidelines for the development of sanitation. The general accepted handbook for the development of settlements describes a maximum distance of 50 meter between households and toilets, with a maximum amount of 20 users per toilet-seat (sphere, 2011).

To meet these requirements, sanitation is developed separate from the households themselves, but as part of the housing blocks. Doing so creates the opportunity for the development of more toilets then recommended and creating capacity for further growth of the community.

**Domestic water management**

Decreasing the dependency on external water sources can be reached by the catchment and storage of rainwater. The water stored in tanks can be used for domestic use.

After use, the effluent water can flow into a system of swales, wetlands and canals to infiltrate into the soil carried towards other facilities.

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**Fig. 4.18 Components integrated in housing developments**

**Fig. 4.19 Integral housing developments program**
In combination with other elements inside the overall vision, the urine diverting (UDD) toilets have been selected as most suitable solution for sanitation. Using a urine diversion toilet to separately collect faeces and urine, creating the potential of reuse of both.

The UDD toilet is a form of eco-sanitation. The strength of this system is the separate collection and temporary storage of faeces and urine. In combination with the composting facilities at the production locations, both human waste materials can be reused in the form of compost and fertilizer.

**Use of composting toilet**

The dry-composting toilet has great opportunities to increase the flow of nutrients and create a close metabolism inside an urban area. The ability to re-use the human waste as input for agriculture is a widely accepted principle.

Building dry-composting toilets is no different compared to other sanitary facilities. It is the use of the toilet that is different. The separation of faeces and urine recommends the user to pay attention while using the toilet. The drain of the urine is located in the front of the toilet, while the faeces will be dropped into a container underneath the seat.

After use of the toilet it is of great importance to cover the faeces with organic material, most common in Haiti is the use of bagas (Kramer et al., 2001). Bagas is a rest product of the sugar cane production and is widely available in Haiti.

In the compartment underneath the toilet seat two containers are located for the separate collection of faeces and urine. Most commonly is the use of buckets for faeces and a jerrycan for urine. Recommended by project using similar technologies is to regular collect both containers and transport them to a composting plant.

The toilets will be developed in groups, integrated into the housing plans. The benefit of separate development is the possibility to integrate hand washing facilities into the sanitation units and more important a more central collection of the waste materials. Both will influence the performance of the sanitation units positively. Depending on the size of the housing developments the amount of toilets per plan can change. The requirement of 20 persons per toilet-seat is the leading factor in the selection of toilets to be developed.
HOUSEHOLD WATER & WASTE MANAGEMENT

As part of the housing development, water management in the form of water catchment and filtration will be developed to support the development of the households.

**Water catchment**

To overcome high levels of dependency on external sources of water suitable for domestic use, water catchment possibilities will be developed to collect non-potable water. Depending on the local weather conditions, the amount of possible catchment per month can be calculated, based on a determined size of surface that can be used for the collection of water.

The storage capacity will be determined by calculation of potential domestic water use combined with the possible days without rain. The additional capacity created by using this equation will create a buffer that can be addressed during the days without rain. Depending on the outcome of these calculations, the size of storage tank will be determined.

**Grey water disposal**

As part of the overall water management system, the domestic produced grey water will flow through rain gardens towards the green-blue lines to end up in the wetlands that filter the water before it enters the canals. The rain gardens incorporated in the housing developments filter the water coming out of the houses plus the grey water that flows out of the hand washing facilities that are part of the sanitation units. The filtration of plants purify the water of pesticides in the grey water to levels that the water can be applied on the production locations.

The rain gardens incorporated in the housing development form the first step in the filtration line to reuse grey water for irrigation of the productive fields.

---

Potential water catchment calculations:

**Average rainfall per month**

\[
\text{Potential water catchment (roof surface)} = \text{Average rainfall per month} \times \text{Potential water catchment (roof surface)}
\]

Storage capacity calculation:

**Daily non-potable domestic water use**

\[
\text{Water storage capacity} = \text{Daily non-potable domestic water use} \times \text{Days without rainfall}
\]

---

Fig 4.22 Principle of rain garden to filter grey water (Rainharvest.co.za)
**Fresh water delivery**

In addition to the storage of non-potable water, potable water can be delivered in a more central system, included into a system of socio-economic facilities. The location of these spaces will be concluded depending on the existing local conditions, see page 86.

**Domestic waste collection**

The collection of domestic waste can, same as potable water distribution, be integrated into the development of socio-economic facilities. On the site of the housing developments, it is important to enhance the possibility of temporary and safe storage of domestic waste, both organic and inorganic. This can be done through the development of small containers that can be closed.
HOUSING PLANS

Through the creation of building plots the described solutions can be integrated in the housing plans. The building plots in themselves can be part of another scale of urban spaces that support the livelihood of the community. To support a full integration of these building blocks in the project area, a standard housing block is developed. Depending on the local conditions in combination with the design principles introduced further on in this strategy, this standard housing block can be used and adapted to fit in the existing urban conditions.

As described above, the housing blocks will incorporate sanitation, water catchment and grey water filtration. Based on housing plots of 6 by 6 meter that can be build freely by the housing owner themselves, a system of layers will be introduced to form a transition between the private and public spaces inside the involved settlement.

The basis of 36 m² plots will be used to create a building block containing multiple plots and sanitation facilities for the people living inside the building block. Inside this block the first level of water filtration in the form of a swale is incorporated in the semi-private open space created by the building blocks.

Depending on the local conditions in combination with the design principles the shape of the building blocks will be determined. As a result small public spaces can appear due to the incorrect connections of roads, green spaces and water lines. These small spaces can be used as small public spaces. One option is to create playing facilities for children in these spaces, or benches for people to gather. These spaces will form an addition to the creation of a network of public spaces that support the livelihood of the settlement.

The public spaces that work on the scale of the community can be created by further expansion of these building blocks. If these block do not fully align along main street, or spaces are not suitable for housing development, they can be developed as communal public spaces.

These steps in scales of use of the open spaces supports the formation of a transition between the private and public spaces.

Fig. 4.24 Housing development scheme
SPATIAL COMPONENTS | 3. SOCIO-ECONOMIC DEVELOPMENTS

One of the key elements in the creation of the network to support the livelihood of the involved settlement is the development of social and economic facilities that support the development of social capital and the creation of local economic activities. The development of these functions will be based on the spatial possibilities of the possibilities. Possible socio-economic facilities that can be developed are:

- **Sport fields**, on central flat spaces.
- **Water distribution** points at well accessible points in the community.
- **Community centre** at central points in the community. The centres can be used for communal gatherings.
- **Communal health care centre**
- **Schools**
The different developments under taken as part of the development strategy and in line with the development of connections between multiple nodes, the road network forms an important element in the creation of the network structure.

The development of a road typology focuses on three main aspects:

- **Hierarchy**
- **Drainage**
- **Connection to buildings**

**Hierarchy**

The road section shown in figure 4.x shows a schematic overview of the road sections. Depending on the importance of the road this section can change to support the preferred hierarchy. The width of the streets can differ to allow a better movement on these connections. For instance, roads of the first order require a minimum road width of 6 meter, excluding pedestrian paths. Roads in the second order can be smaller, for instance 5 meter, decreasing the possibility of movement in two directions. This can help in slowing down the movements, creating more opportunities for connections between the houses and the roads or activities.

**Drainage**

An important part of the development of the roads is the connection with the water management. Introducing swales as part of an overall drainage network will decrease amounts of water on the road surface and create a possibility to increase the infiltration of water into the soil. At the same time will these lines be used in case of heavy rain as throughput towards water lines.

**Connection to buildings**

To allow access to the buildings adjacent to roads, pedestrian paths are integrated into the road design. These spaces of minimum 1 meter wide allow people to walk along the streets and allow access to the buildings. In Haiti many buildings include porches at street sides increasing the connection between household and streets. The pedestrian paths forms a secondary transition between private and the public street.
**SPATIAL COMPONENTS | 5. SLOW INFRASTRUCTURE LINES**

To support the developed road network, slow infrastructure lines will be created. These slow connectors will be developed to increase the possibilities of slow traffic, pedestrian and bicycle, to move more freely through the involved settlement.

A second important function these connections is the link of the spaces between the households and the settlements main infrastructure at places where houses are detached from the roads. Through a system of pathways, stairs and small public spaces, slow infrastructure lines can create a second layer in the hierarchy of the connections. Focusing only on the slow traffic, the layout of these connections can focus on more green aspects of the spaces.

At places where the slow infrastructure lines connect to productive spaces, the lines can be designed as part of the productive landscape, continuing the production of foods into the settlement itself. This strategy will help in strengthening the visibility of the production while at the same time it can be used as part of an urban greening process.

Same as in the road network, the slow infrastructure lines can be used to develop a network of drainage lines inside the settlement. Through the development of swales, integrated into the slow infrastructure lines, the swales can be used for the filtration and infiltration of grey water and storm water runoff.

---

**Fig 4.28 Schematic Slow Infrastructure**
An important part of the water management structure are the water lines. These connections between multiple sources of water, production locations and outflow to the external sources are essential in the creation of an overall system of water management on the scale of the involved community.

The design of the waterlines is based on the principles of slowing down the water to decrease the potential erosion and increase the possibilities of infiltration of water into the soil. To promote these two effects check dams and plantation will be integrated into the water lines.

The size of the water lines needs to be determined based on the amount of water flowing inside the settlement. Depending on these conditions the section of the waterlines can differ.

**Check dams**

Partly blocking the flow of water by the erection of small check dams will slow down the water. The decrease of flow velocity will reduce the erosion of the canal and increase the settlement of sediment. Check dams will create small ponds behind the dams offering possibilities for filtration and infiltration.

In case of heavy rainfall the check dams can overflow to prevent possible flooding of the canal.

One opportunity in post-disaster situation is the likeliness abundance of construction materials due to destruction. These materials can be used for the construction of the check dams.

**Plantation**

The second opportunity of the development of the waterlines is the potential of natural filtration by plants.

One of the plants that can be used for the filtration of water and thereby is enriching the natural environment is Pickerel Weed.
4.3.5C IMPLEMENTATION OF VISION – INTERVENTIONS DESIGN

Once the network of nodes and connections has been formulated, the network needs to be translated into a spatial design. Using multiple principles that can be applied in different situations, a system of basic interventions will be developed. These basic interventions all support the earlier developed functional and spatial connections between the functions. While during the previous step the nodes were the leading element for the creation of the connections, in this phase the development of the connections will be designed in order to let the connections be the conditions for the development of the program of the nodes. This phase focuses on the creating of spatial conditions for the development of the program created earlier on.

The development of the connections using the principles developed in this phase of the project depends on the level of importance of the connections. The hierarchy in importance reflects the importance of the connections in facilitating urban agriculture and support a sustainable development of the settlement.

In light of the overall structure of the project, the aim of the connections which will be created is to facilitate the development of urban agriculture, therefore the following sequence of importance is introduced:

- Green lines connecting to water streams inside the community.
- Creating links to infrastructure network.

The development of these two connections have the priority due to their capacity to support the development of a water management system and movement of both people and water through the settlement, thereby establishing first possibilities for the development of an internal network.

Once these two connections are developed and form the backbone for further development of nodes and connections, additional principles will be introduced which focus on the spatial layout of the different nodes. For the productive locations and the socio-economic facilities will no principles be developed due to the small scale (facilities) and the possibility to change the layout of the productive locations to facilitate possible changes in the production system. In both cases will the development of principles constrain the layout, thereby constraining possible changes during future developments.

The additional principles designed for the housing plans aim at providing a clear network of connections and open spaces which together create patches of land suitable for housing developments. The network of connections surrounding the households will be able to facilitate the basic functions introduced earlier. Other than the previous principles which focus on the ability to support water management and movement of people and goods, these principles focus on the creation of better housing development through the incorporation of climatic design principles providing simple but efficient interventions to improve the quality of the housing developments.

The principles that will be implemented in the development of the housing plans are:

- Provision of open public
- Orientation to accommodate natural wind flow for cooling
- Orientation of sun for provision of natural shade
First of the principles to be developed in order to implement the previous developed urban web into the real situation of the project area is the structuring of the green lines which connects the community to water streams. Goal of these developments is to create a continuous network of green lines that support the water management system. The support will be generated through the design of constructed wetland systems connecting the households to the main water streams. As can be seen in figure 4.13 the green lines incorporates both public spaces, food production possibilities and water management lines. A drainage system developed as part of the water management system is included into the green lines, providing spaces for larger amounts of water to accumulate, slowing down the throughput of water resulting on a decreased pressure on the main water lines.

The input of these will be provided by mainly the households connected to the green lines. The grey water coming out of the households will enter the green lines where the effluent water will be filtered on its way to the water streams.

Grey water constructed wetlands can be incorporated into the urban environment filtering domestic grey water, reducing the amount of pollutants in the effluent water through biological processes (Yocum, N.D.).

**Design Principles | Green Spaces**

<table>
<thead>
<tr>
<th>Domestic grey water</th>
<th>Grey water filtration wetland</th>
<th>Flow towards water stream</th>
</tr>
</thead>
</table>

Fig. 4.31 Principle of green lines development

Fig. 4.33 Reference image of constructed wetland, Dominguez Gap Wetlands, Los Angeles, (Long Beach Natural Areas)
DESIGN PRINCIPLES | INFRASTRUCTURE CONNECTIONS + PUBLIC SPACES

The integration of the complete settlement including the new developments into the mobility network will increase the performance of the urban web. To increase the number of through going routes, new developments will be designed to maximize the number of connections to the existing main infrastructure.

Depending on the amount of possible movement along the connection the roads will be designed to be able to handle the movements it will endure. The connections will be created by searching for the fastest and most direct connections towards the main infrastructure of the developments.

In combination with the green lines, the infrastructure connections will form a spatial framework to guide the development of the project area. Directed towards the development of the housing plans the two connections combined form lines separating plots of land that will be used for housing.

To overcome possible over population of the involved community, a percentage of the area under development will be reserved for the development of green and public spaces. The creation of these spaces will support the livability of the community. Especially the creation of public spaces will support the quality of the settlement. Public spaces can be used as spaces for the community to get together and have social activities, supporting the social cohesion of the community. The creation of public spaces also creates the possibility for small commercial activities to take place. For instance small bars or markets flourish around small public spaces designed for the community to meet.

Fig. 4.34 Creating connections to main infrastructure
In addition to the previous principles the next two will focus on the climactic aspects of the urban developments. By applying an orientation towards both wind and sun, these two aspects can be used for the passive cooling of the urban landscape. This can lead towards a more pleasant urban environment that stimulates decreasing the urban heat island effect (Kim, 1992). These two aspects will influence the climate in between buildings, thereby contributing to an improved ecology of the built environment. In combination with the development of more green and water in the community, the energy footprint of the community can be reduced. Through these technologies a more sustainable community can be developed.

**Wind;** can be used to cool the spaces between the buildings through the flow of wind between the buildings. Although there is a lack of literature and research on this topic, the main principles of orientation towards the most frequent wind direction can help to improve the flow in wind inside the urban area. Creating wider spaces for the wind to pass through the urban environment will stimulate the flow of wind, creating a cooling effect.

**Sun;** orientation can help in the cooling of the urban environment through the creation of shading. The urban heat island effect can be countered by this. Next to that it can create pleasant outdoor gathering spaces.
In order to test the strategy developed earlier on during the development of this project, the community of Tisous is selected to function as the test site.

In order to understand the potentialities and constraints of the development of the community using the strategy, it is essential to understand how the community is build up, functionally and spatially. The community is analysed in to create a complete overview of the community to assist the use of the strategy and create a development plan for Tisous.
5. ANALYSIS
MASTER PLAN

5.1 PROJECT AREA SELECTION
5.2 TISOUS CONTEXT
5.3 TISOUS - COMMUNITY PROFILE
5.4 TISOUS - SPATIAL ANALYSIS
5.5 SWOT ANALYSIS
5.6 ANALYTICAL OUTPUT
PROJECT AREA SELECTION

Applying the strategy developed before in chapter 4 into one of the many informal settlements Port-au-Prince forms the test of the potentials this strategy has to offer for informal settlements in Port-au-Prince or other developing cities.

The focus on one informal settlement of the Port-au-Prince metropolitan area underpins the potentiality of this strategy. By building up smaller communities and supporting them to improve the urban, living, conditions in these communities will support the development of the whole city and region. The bottom-up approach of this project stimulates the formation of multiple centres of urban development, decreasing the demand on the formal city.

The development of underdeveloped urban settlements along the fringe of the city will create more complete urban neighbourhoods instead of the many commuter settlements the city is build up out of at the moment. The support of local developments in multiple parts of the metropolitan region will increase the strengths of the urban fringe of Port-au-Prince instead of the pull-aspects of urbanization that are present in the overcrowded inner city of Port-au-Prince. The development of the city’s fringe will generate less internal movement and pressure on the formal city and a stronger and more urban fringe to support the formal city.

One of the informal settlements of Port-au-Prince meeting the criteria set for the selection of the project area is the Tisous community.

After a first quick analysis of the local conditions the community was selected based on the very low level of urban development. Although the community is part of the metropolitan region of Port-au-Prince, the urban conditions can be described as rural. The community is missing any form of organization of the build environment and socio-economic functions. Basic functions are missing and population is poor.

The combination of these aspects makes Tisous an community that needs development and during this project the strategy will be applied in this community to test its potentials.

During the extended analysis of the spatial conditions of Tisous the low level of development will be described more thoroughly.

Fig. 5.1. First experience of Tisous
The development of Tisous can be the start of many other similar developments of informal settlements that are part of Port-au-Prince. The strategy that has been developed focuses on the creation of links between the separate functions, nodes and connection. The same strategy can be applied for the larger scale, meaning that different settlements can be linked to each other, expanding the network over the city. This will create a city-wide network of well connected urban spaces supplying the basic functions to a large part of the urban population, hereby supporting the overall development of Port-au-Prince.

Fig. 5.2 Marginalized settlements in Port-au-Prince
Founded on former agricultural land on the fringe of the city, the community of Tisous started to grow from 1970’s on taking over the agricultural land and started to form the informal settlement it is presently.

Named after the many small sources (petite-source of water in the surrounding of the community, water still has a major influence on the local urban conditions. The community is bordered by streams of water and larger streams of water run through the community.

Within the Port-au-Prince metropolitan area, the community of Tisous is part of the commune of Carrefour, one of the five communes that form Port-au-Prince. Located along the city’s main connected towards the west of the country, the community is one of the first urbanized areas people encounter driving into Port-au-Prince. Although the Route Nationale is the main connection of Carrefour towards the rest of the city and the west of Haiti, it also forms a barrier for movement. The high level of connections and dependency on one single road creates congestion along its complete route inside Port-au-Prince.

Carrefour was struck very hard during the 2010 earthquake, a large part of the urban environment was destroyed after the disaster. The high level of destruction accounts also for Tisous. Main factors of influence are the high level of poverty and lack of controlled building constructions in combination with poor topographic conditions.

The location of Tisous in coordination to the Route Nationale clarifies the development of Tisous. Due to the need of expansion of Port-au-Prince since the 1960’s onwards, the city has expanded along its main infrastructure connecting the city to the rest of Haiti. Result of this growing city is the congestion it is causing. Main roads are clocked up with cars, creating heavy traffic jams, resulting in a closed off city with no connection to its own fringe and beyond and even disconnecting the internal city. Tisous can hardly be considered part of the city based on travel times between the community and the inner city.
Fig. 5.4 Tisous in relation to Port-au-Prince; based on Defense Mapping Agency Hydrographic, 1994)
TISOUS – COMMUNITY PROFILE

Demographics
There are no reliable statistics of the demographic conditions in Tisous available, mainly due to the lack of proper administration in Haiti.

It is estimated that within the project area of Tisous 10,439 people are living within 1937 households, although it is believed to house around 15,000 people. According to on-site analysis of Cordaid, the community of young age and most of the people are female, resulting in a high number of female run households.

Due to the lack of reliable demographic data the need for facilities within the community is hard to account for.

Economics
In the community there is a low level of income and for a large part of the households it is hard to sustain their livelihood. In the community itself there are no formal market places, only some small scale street vendors. According to Cordaid there is a lack of livelihood structure and opportunities (Cordaid, 2011).

Urban development
Tisous is an underdeveloped urban area. The basic urban facilities are, in general, missing or unreachable for a large part of the community. The lack of access to clean water, sanitation and hygiene form health risks.

Although half the population uses and depends on the national water distribution network, about half of the rest of the population prepares their own drinkable water.

The Sanitation facilities in Tisous are in an even worse state. A part of the household does not have any form of sanitation facility (6.7%). The largest part of the community is using (improved) pit latrines (81.6%) for sanitation needs, causing both environmental and health care hazards.
Area surface 530.195 m²/0.5 km²
Average density 196 inh/ha

10439

1937

5.4

Women 46%
Men 54%

CAMEP (national distribution)
Trucks
Stream
Wells
Domestic treated water
Well and stream
Other

1001 51.7%
6 0.3%
477 24.6%
41 2.1%
409 21.1%
1 0.0%
2 0.1%

Toilet
Improved pit latrine
Pit latrine
Septic tank
Neighbor
In the field
others

75 3.9%
22 1.1%
1559 80.5%
25 1.3%
11 0.6%
129 6.7%
116 6.0%

Fig 5.6 Tisous demographics (Based on Cordaid, 2011)
TOPOGRAPHY

The community of Tisous is build up along the two hillsides of a ravine created alongside two water streams. The hillsides are thereby forming the main characteristics of the community. The situation of Tisous running up along the hillsides has determined the development of the community. Characteristically for the community are the stagged building upwards along the hill, while the water streams are creating narrow trenches through the community. These characteristics are seen all over Port-au-Prince where most informal settlements are build up in the marginalized area that once used to be the fringe of the city. Over time the hills have been taken over by the population and they are now forming the character of the city.

As can be seen is the topography of Tisous at some locations steep (above 35% inclination), resulting in hazardous locations for building development. Due to these circumstances, a part of the community was destroyed during the 2010 earthquake, as a result of landslides being trigged by the movement of the soil.

Problems + potentials:
- Large areas exceeding 35% inclination
- Community build up along hillsides creating challenges for connectivity

Fig. 5.7 Housing build on top of each other to overcome high differences
Fig. 5.8 Slope contours and inclination map of Tisous
OPEN LANDSCAPE

Characterising the community of Tisous is the continuous flow of housing along the hillsides, leaving only a small portion of the settlements landscape open for other use. Within Tisous there are only several separate patches of open landscape visible. Although there is no system of why these spaces are still unoccupied, most likely they are open because of risk of flooding or landslides.

In the case of the northern open space, flooding is a regular problem. The lack of water management in the community results in flooding of the open space, resulting in a large unoccupied space in the middle of the community. Currently this space is used as a communal washing facility. Daily, many people are washing clothes, foods and themselves. Although it is used for communal use, communal facilities are missing.

Other patches of open landscape have different uses. In the aftermath of the earthquake internal displaced people (IDP) camps are set up on the open spaces.

Inside Tisous there is no evidence of organized public spaces. The only form of semi-public spaces can be found around the schools, but those spaces are only accessible for the users of the schools. The lack of public spaces that create the possibility for communal events can be linked to the anarchic development of the community. The missing planning of Tisous resulted in an un-organized development of all aspects. Without any form of guidance, construction were build up all over the landscape without any regards to public or private space or infrastructure. The un-organized form of development forms challenges for the further development of the community and therefore needs to be addressed as soon as possible to overcome future problems related to this development.

Problems + potentials:

- Organized public spaces are missing
- No clear structure of green or open spaces inside the community
Fig. 5.9 Open landscape in Tisous

Fig. 5.10 Northern open space

- Green open spaces
- Sports field
- Small inactive plantation
- Route Nationale no. 2
- Community borders
CONNECTIONS - ROAD NETWORK

Although Tisous is located along the Route Nationale, the connectivity of the community is low. Along the Route Nationale there are several small connections, but there are only two connections running uphill inside the community. These two connections are the only ones Tisous has with the rest of the city. Along the two main connections, many smaller roads connect the different parts of the community together, creating a tree like structure of roads and pathways. The chaos and un-organized structure of roads results in a high diversity of streets and paths, all with different sections or and use.

In general roads are the rest product of housing development. Depending on the location of the buildings the roads meander through the community. The result is a unclear network of roads. Mainly in the densely build hillsides of the community, the pathways form the only connection to many households. The lack of organisation created pathways of 1 or 2 meters width, undermining the connectivity of the households.

The condition of the roads are of very poor quality. Due to the lack of infrastructure development all roads are build up without the use of pavement material, resulting in dirt roads filled with holes. The low level of road conditions forms a major constraint on the possibilities of movement through the community.

As can be seen in figure 5.x, stairs are, partly, build up out of old tires to create any form of steps along the many slopes of the community.

At many places drainage is not included in the roads. During heavy rains roads are covered with water, most often carrying domestic waste through the community.

During the reconstruction phase the road condition formed a major constraint on the possibilities of transport. In many cases complete houses needed to be carried up steep hillsides to end up on the right location.

Problems + potentials:

- Lack of hierarchy
- Poor conditions of road
- Any form of organisation is missing
- Difference in road sections decreases movement (narrow vs wide sections)
Fig. 5.12 Road network of Tisous
WATER NETWORK

The community of Tisous is built up along hillsides with two water streams running through the settlement. The topographic conditions create a natural flow of water through the community downwards to the Port-au-Prince bay, towards the north of Tisous.

The name of Tisous is referring to the many streams of water in the community and its surroundings. Within the borders of the community, three main streams of water can be found. Two of them are canalized, control the flow of water through the community. But there are also parts that are not canalized, resulting in streams of water running over the streets.

In combination with a lack of drainage a large amount of water is running over the streets.

The state of the canals in Tisous is worrying. The walls of the canals have not been built up, resulting in the erosion of the canals, carving wide and deep canals inside the community thereby creating safety hazards due to the difference in height.

To add to this problem, large parts of the canals polluted by domestic waste thrown into the canals blocking the flow of water.

Within Tisous there is no water management system present. The flows of water are hardly controlled and the access points to clean water, provided by the governmental CAMEP or through the availability of wells, are not organized. Same problem can be seen for washing facilities. Although the northern open space is used for washing, there are no organized system of washing facilities inside Tisous.

Next to the problematic situation of the canals, there are no initiatives to control the water system through the use of water catchment for instance.

![One of canals of Tisous. No walls present and canal filled with domestic waste](image)

Problems + potentials:

- Poor quality of water streams
- No drainage system available
- Scarce availability of water
- Water management is missing
Fig. 5.14 Water network of Tisous

Fig. 5.15 Water distribution point Photo A. van Amerongen

- Water points +50 m mark
- Uncontrolled Natural water streams
- Water streams
- Direction of water flow
- Route Nationale no. 2
- Community borders
DENSITIES

Tisous is a densely build community, with an average density of ±200 inhabitants per hectare. But within the community the density is more spread out, resulting in areas with a high density and parts with a lower density. As can be seen in figure 5.13 the density in mainly clustered in three areas that are linked to each other by parts with a slightly lesser dense areas. The three clusters that appear on the map are located in the north, where the community links to the Route Nationale. The second is in the middle of the community and the third on the south side of the community, towards the top of the hillsides.

The first cluster can be explained as the start of the community. This is most likely the spot where the community started to grow. The close relation to the only connection towards the rest of the city is the main attractor for the density. Another aspect that is visible in this part of the community is the scale of the buildings. This cluster is further developed than the rest of the community, as can be seen on the size of the buildings in this area. The cluster in the middle of the community is most likely the result of the connections the place has. Around this point there are several roads going up the hillsides connecting the southern part of the community to the northern part. This also relates to the geographic position. This point is where the two hillsides, east and west, meet to open up more towards the north. This cluster spreads out towards the school and hospital. The third cluster of density is located on the southern hilltop of Tisous. The density in this relatively new development can be explained by its geographic characteristics. The Location of towards the top of the hillsides is relatively easy to build on, without the need for complex constructions to prevent landslides.

Problems + potentials:
- 3 existing concentrations of dwellings
- High & medium high densities

Fig. 5.16 Densities in Tisous
The community of Tisous is build up against hillsides surrounding a river. The northern border of the community is formed by the Route Nationale no2. The road between Port-au-Prince and Léogane. The height difference in the area is big. The north of the community is at sea level, while the southern borders are at 120 meter above sea level.

The community is build up against the hillsides, creating superdense and vertical settlements. Since the start of urbanisation there hasn’t been any spatial framework for development, resulting in a high level of anarchic constructions. The houses are build along side each other, leaving no space open for roads, community spaces and other facilities. The high density and poor construction of most of the houses is one of the main causes of the high level of destruction during the earthquake.

The development of Tisous started at the area along the Route Nationale. In this area is currently the most developed one. Along the hillsides on the eastern and western border the highest densities can be found. These areas are build along the hillsides with little room left between the houses. The southern developments are the most recent ones, therefore is the density lower in these areas.

Inside the community there is no fixed building typology. The high level of anarchic development is also visible in the dwellings. Buildings are build in different sizes, heights and materials. This development makes it harder to recognize any form of rhythm. Making it difficult to develop any form of hierarchy.

For a community of 10.000 people there is a very small base of facilities in the community. At the moment there are three schools in the community, of whom two are used. The other one is destroyed during the earthquake. Furthermore there is one health care facility to support the community and a sport field, currently used as IDP campsite. Within Tisous there is a lack of economic activities, there is no formal market place and there is a lack of official shops. Most of the sellers are street sellers.
**SWOT ANALYSIS**

**Strengths**
- Poor households create strong community.
- Essential urban functions are missing, creating the potentials to develop them according to modern and sustainable criteria.

**Weakness**
- WAter, Sanitation and Hygiene program is missing.
- Low level of livelihood inside Tisous.
- Need for participation of local community.
- Missing connections, internal and external.
- Lack of social and economic facilities to support the community.
- Need for external resources to support project development.

**Opportunities**
- Multiple open spaces inside the community with different characters.
- Young population, curious for improvement of life and living conditions.
- Water streams are present.

**Threats**
- Unsuccessful integration of waste management resulting in clogged up water streams.
- Economic possibilities of local population.
- Anarchy in the built environment creating friction between needs and possibilities of development.
- Proposed solutions are too complex and technical for uneducated population.
- Central and regional governments are missing, policy support can be hard.
The low level of urban developments Tisous has encountered so far in combination with the redevelopment process of the 2010 earthquake creates unique opportunities to build up a integral urban neighbourhood of Port-au-Prince. The chances the development of Tisous offers can influence the livability and quality of life of the local population. Stimulating the population to use efficient and eco-friendly technologies for the essential functions can create an unprecedented level of self-sufficiency. The potential reduction on external financial, social and natural resources will create an improved urban community that is more resilient to future disaster situations.

Local needs:
1. Development of the essential functions.

2. Creation of usable urban landscape in the form of food production and public spaces to support the local community.
3. Development of social and economic structure to support local livelihood.
4. Development of awareness on environmental and construction levels to increase the resilience against future disasters.

Development goals:
1. Creation of functional links between multiple essential functions to support the quality of life inside the community of Tisous.
2. Development of a spatial framework of interventions integrating urban agriculture in the development of the community.
3. Linking the community to external connections, increasing the connectivity and potentials of Tisous.
4. Strengthening of the built environment through the development of the spatial framework in combination with the local awareness of the need for development.
After the analysis of Tisous, the developed strategy will be tested on the community. This chapter aims at clarifying the implementation of the strategy in the community of Tisous. The different steps, part of the development strategy are followed to build up the CAP. First the different stakeholders are analysed after which the different functions can be linked and the urban web structure is developed. The different steps are then formed into a development vision for the Tisous community.
6. TISOUS DEVELOPMENT VISION

6.1 PROJECT START | DEVELOPMENT FRAMEWORK
6.2 STAKEHOLDERS
6.3 DEVELOPMENT GOALS
6.4 VISION | LINKING OF FUNCTIONS
6.5 VISION | URBAN NETWORKS
6.6 TISOUS DEVELOPMENT VISION
6.1 PROJECT START | DEVELOPMENT FRAMEWORK

The destruction of the earthquake offers the opportunity to start the integral development approach developed in chapter 4 for the community of Tisous. The analysis of the community in chapter 5 gives a clear image of the poor urban condition the settlement is in presently. The lack of basic functions in this community therefore forms one of the main drawbacks of the human, social and economic development of the community.

As part of the Carrefour commune, Tisous can be developed according to a local development framework as part of this commune as the spatial frontier. The implementation of the strategy and formation of a development vision for the community is the step that needs to be taken in this stage of the project developments.

The first step is the recognition of both the stakeholders and the most urgent needs of the community. Each of the stakeholders have their own needs and urgencies of development. The creation of consensus between the stakeholders and transforming the individual programs into a cooperating program that integral develops the basic functions is the most important goal of the involvement of the different stakeholders. Based on the needs and urgencies development goals can be formulated. The formation of the project goals depend on the needs and problematic situations found inside the community in combination with the possibilities of the other stakeholders. The development goals are stated in sequence to the analysis of the community in the previous chapter.

Once the project goals have been formulated for the Tisous community the first linked functions diagram will be translated into a spatial diagram of how the different functions can be integrated into each other and how the proposed solutions spatially can be connected to each other.

Next step is the implementation of these functions into the spatial configuration of the community. By using the spatial analysis and the maps made during this step as the basis for the development of a urban web structure that contains the different elements described in chapter 4.6 a spatial development vision can be created. This development vision then contains the spatial integration of the different basic functions and the element located inside the Tisous community. This development visions forms a major part of the Community Action Plan that will help the community and the other stakeholder in the development of Tisous into an integrated settlement in the metropolitan region of Port-au-Prince.
For the project in Tisous, the different stakeholders should have a common interest in the development of the settlement. Although the weak national government is not capable of supporting the development process at the moment due to insufficiency of national government and incompleteness. After the earthquake many NGOs started working in the devastated areas to build up the settlements and help the communities to build up their life again. The NGOs will also be used as the initiating party in this process. The community support by the NGO forms an important aspect in making the implementation and empowerment of the community possible. The community is of great importance in order to find both the real and perceived problems inside the community. The community can be represented in the development process in the form of a CBO.

In order to be able to develop a integral version of the functions network it is important to have experts inside the project team to increase the technical integrality of the project. The availability of knowledge supports the developed strategy through the improvement of potential connectivity of functions. This knowledge will be provided by experts that are supplied the Haitian governmental bodies, UN organisations and NGO experts. The knowledge they provide will be combined with the needs of the community to set the project goals before a integral development vision will be drawn.

To enable a integral development of the Tisous community in coordination to other settlements in the Carrefour commune it is important to have one or more persons inside the planning team who are capable of 'looking at the bigger picture'. although it is desirable for the Tisous community to have its own facilities, some of them can best be developed in cooperation with to settlements. Local governance is such a player who is responsible for the more general developments. Inside the project team each player has its own task and visions for the development of Tisous. To support the integral development of the plans, the equal recognition of all parties is important.
6.3 PROJECT GOALS

The community of Tisous is highly underdeveloped and can almost be characterized as an rural settlement. The lack of sufficient forms of urban development and anarchic character of development require the integral development approach developed. Next to the general goals of this strategy, there is a high need for the upgrade of the urban environment. Currently the settlements layout counteracts the affords of development.

The combined recognition of needs and stakeholders after which the cooperative development and implementation can be started is the basic element behind the development of this project. The creation of the cooperation between stakeholders is therefore one of the main needs in this project fig.6.3.

In combination with the general goals which are an integral part of the development strategy the main goals set for the development of Tisous are:

1. **Creation of functional links between multiple essential functions to support the quality of life inside the community of Tisous.** These facilities are:
   - WASH (WAter, Sanitation & Hygiene) program
   - Planned housing developments
   - Clear infrastructure network including roads and public spaces.
   - Water management program
   - Waste management program

2. **The creation of a strong spatial framework creating the link between productive and urban spaces to enable the movement and coherence between the two developments, thereby supporting the overall development of the community of Tisous.**

3. **Enable the expansion of the framework outside Tisous, increasing the inclusion of Tisous in the larger network of the Port-au-Prince metropolitan area.**
6.4 VISION | LINKING OF FUNCTIONS

Fig. 6.4 Creation of web of nodes and connections for the development of a settlement

Growing future Haiti | Msc Thesis Peter Arnts
FUNCTIONAL NETWORK

The diagram showing the links between different functions shown in figure will be translated into a more spatial diagram showing the different components that will become part of the spatial network inside Tisous. Multiple technologies have been selected to form the functional network. Most important development in this is the use of compost toilets inside the housing developments. These toilets do not need water for flushing plus the human waste can be collected and compost into soil fertilizer for the productive locations.

As part of the housing developments the organic and human waste will be collected on-site before it will be transported towards separate composting facilities that are part of the productive locations. The composting facility is split up into multiple compartments that all focus on one specific part of the composting process.

Separate from the housing developments and the composting facilities, the water filtration system will be integrated into the waterlines and wetlands that will be created. After the filtration, the water can be used inside the washing facilities or directly at the production locations.

The significance of this scheme is the possibility to use as an educational tool for the unskilled population of Tisous. Through the development of clear links between the different functions, the population can start to understand the urgency of using the network. If one of the elements is not performance according to plan, the whole network can stop working.
Overview of integrated Water and waste management system in Tisous

Rainwater harvesting

Urine diverting toilet

Organic waste collection

Greywater treatment wetland

On-site storage in jerricans

On-site storage in buckets

Co-composting of solid waste

Drum & car washing facility

Bagas storage facility

Staff facilities

Handwashing facility

Collection & transport to of-site fertilizer plant

Retention ponds

Use for washing facilities

Use for irrigation

Collection of leachate

Secondary filtration in green lines

Cascade of plant filtration

Detention pond

Constructed wetland

Fertilizer/irrigation

Irrigation water

Outflow of water to waterstream/sea

Return to local community

Local food production

Compost

Windrows

Urine holding tanks

On-site storage in jerricans

On-site storage in buckets

Phase 1 2 month storage

Phase 2 4-6 month storage

Urine/Feaces

Organic cover material

Feaces

Organic waste collection

Housing

Inlet control

Outflow of water to waterstream/sea

Fig. 6.5 Overview of connections between functions being created during development process in Tisous

Sources:
YOCUM, D. Design manual: Greywater Biofiltration constructed wetland system, Santa Barbara, Bren school of Environmental Science and Management, University of California.
The cooperation between the separate functions introduced in the strategy will be applied in the situation of Tisous. Based on the analysis all functions of the development program require a certain level of development. To accommodate the development of all functions the complete diagram developed in the strategy will be implemented during the development of the development vision for Tisous.

As can be seen in figure 6.4 the different functions have been linked functionally creating a complete web of integrated programs. The creation of this web accommodates the flows between the different functions, but also hints towards the development fixed components. These components will be used for the development of the urban web that will structure the community.

The components, introduced before, will be build up out of one or more functions, depending on the possibilities to integrate. This process resulted in the following components and their program:

- **Production facilities;**
  - Productive grounds
  - Composting facilities
  - Possibility for creation of constructed wetland for washing units

- **Housing developments;**
  - Housing
  - Dry sanitation unit
  - Household water management program
  - Waste management program

- **Socio-economic places;**
  - Washing facility
  - Public space

- **Infrastructure;**
  - Roads
  - Drainage

- **Slow infrastructure**
  - Pathways
  - Water catchment area
  - Drainage lines
  - Possible constructed wetland

- **Water lines;**
  - Reconstructed canal
  - Filtration system
Fig. 6.6 Spatial development vision for the Tisous community
LANDUSE PRODUCTIVE OR URBAN

The development of the urban web as part of the strategy to upgrade the community of Tisous towards an inclusive and more self-sufficient community of Port-au-Prince will be based on the existing local conditions. The present situation the community is in, is far from ideal for sustainable urban living, thereby not supporting the quality of life.

The urban web which will function as a spatial framework for further development will be created based on the existing local conditions. The combination of the following aspects will determine the layout of the web:

- **Open spaces** (places of development)
- **Inclination** (safe for habitation?)
- **Infrastructure** (possible connections)

Depending on these aspects the nodes and connections introduced in the previous phase will be placed inside the community of Tisous.

Out of the analysis of the existing urban conditions of Tisous, the three aspects will be used to select the location of the nodes and connections.

First step is the selection of possible places for development. The existing open spaces are the key element in the selection of these spaces. In combination with the inclination the function of spaces will be assigned. In case the inclination is above 35% or the spaces are under threat of other risks, productional functions will be assigned to the spaces. If the spaces are 'safe' for occupation, housing development will be the main function of the space.

Second step is creating connections between the nodes. Also during this development the existing situation is leading in the selection of the connections and their functions.

The roads will are the most important for both the internal and external connectivity. To create a well working road system, a simple but efficient system will created, based on the present road structure in combination with possible additions, to create a fluent and highly connected system.

In between the roads a network of slow infrastructure will be developed. These lines will form the connections between housing plans, infrastructure and water lines. These lines are capable of adopting multiple functions of the development program to support the different nodes its connected to.
As can be seen in figure 6.x are some of the patches of open land suitable for occupation, while other are located along spaces exceeding the 35% inclination and will therefore be used as productive locations.

Also visible are the spaces that conflict with the current function based on the criteria used for the selection of the use of the open land. Spaces used for housing are located on top of spaces with an inclination of 35% or more. While the opposite can also be found in Tisous, namely spaces not used for housing (sports field) are located at ‘safe’ spaces. To overcome this problem, these spaces will change function to overcome the impasse.

The result of the selection of spaces is the creation of five spaces that will be used for urban development, and six spaces that will be used for the development of agricultural activities.

Enabling the development of:

- ±34,000 m² for urban development
- ±55,000 m² for productive grounds
To estimate the production possibilities a first assumption of the production capacity of the locations has been made. Based on the FAOstat data on average annual production in Haiti, in combination with the food commodity table, an assumption on the possible productivity of the locations have been made.

For the largest locations in the northern part of Tisous, consisting out of ±26,000m² possible productive grounds the production has been calculated based on the development of productive patches of 1000m². These patches can be used for the production of different products.

It has to be noted that these numbers are rough estimations. The actual production capacity depends on many aspects not integrated into this strategy. Some of these aspects are knowledge on production, soil conditions and the use of fertilizer. This strategy aims at the provision of these factors, but is not capable of giving the precise knowledge.

Another aspect in the determination of the production capacity is the production typology selected for the productive spaces. Based on the characteristics of the sites, the typology can differ. For the northern production location, the most likely production typology is wet production in the form of aquaculture or aquaponics. Aquaponics makes use of the combined production of fish and horticulture. The benefit of this production is the multiple products that can be produced on a confined spaces, but is highly dependend on the available knowledge and technology.

<table>
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<th>Product</th>
<th>Production (Kg)</th>
<th>Energy (Kcal)</th>
<th>Protein (g)</th>
<th>Fat (g)</th>
<th>Carbon (g)</th>
</tr>
</thead>
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<td>87</td>
<td>295506</td>
<td>9850</td>
<td>2877</td>
<td>65029</td>
</tr>
<tr>
<td>Potatoes</td>
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<td>725000</td>
<td>32125</td>
<td>1250</td>
<td>155500</td>
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<tr>
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<td>Cabbage</td>
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<td>1622211</td>
<td>3111</td>
<td>4444</td>
<td>389111</td>
</tr>
</tbody>
</table>

Fig. 6.9 Assumed production calculations, calculated by (FAO, 2012, USDA, 2012)
PRODUCTION NETWORK

Depending on the characteristics of the different possible production locations the site production function and typology can be determined. As explained on page 76 the function of the site can be one of the four production functions, input, production, processing, marketing.

Based on the creation of a circular road network (see page 130) a production system with south-north orientation can be developed. This system is adapted to the layout of Tisous. The south-north orientation offers the possibility to create a food production system that starts at the southern production location with the production of input materials (composting facilities) after which the products can be products at four main production areas and end up along the route national where the products can be sold if the urgent need of the community is covered.

The most southern production location houses the first step of the production process. Towards the north, where the route Nationale connects Tisous to the rest of Port-au-Prince the marketing and processing functions will be located due to their possible need for external resources. By locating them along the most connected spaces a constant in- and outflow can be created for these functions. For the marketing of local produced foods the high level of visibility and connectivity is an important aspect. The more people see the goods, the higher the possible amount of clients.

The production spaces are located in between these two functions, spread out over the community of Tisous.
After the selection of the functions the production locations can be assigned by a main production typology.

Based on the same model also used to assess the potential production function are selected for the different production locations. The typologies that are selected are:

**Horticulture** for the two most southern production locations. The patches of open land are suitable for different products to be produced. Another important aspect is the availability and closeness to direct water sources. Also the direct connection to the circular road system is supportive to the production typology.

**Livestock** production is located along the eastern border of the community. The distance towards the main infrastructure is the main criteria in this selection. Livestock is able to walk to the breeding grounds. Therefore the need for high connectivity is lower then for the horticulture production.

**Aquaponics** production can be located in the large northern location. The large amount of water on that location is the main aspect of this production function.
ROAD NETWORK DEVELOPMENT

To support the nodes created a road network will be created that connects the nodes together. By using the existing infrastructure as basis for the creation of a clear infrastructure network the road network will be anchored inside the community. By creating a simple and efficient circular system of roads which connects the nodes together, a community wide ring road is created to support maximum movement inside the community.

In addition to the development of the internal road network, two connections towards the settlements towards the east and west of Tisous will be created to support the movement between the communities themselves. This second east west connections thereby creates opportunities for further development of the community, through the improved connectivity of Tisous.

The strategic location of the connections creates possibilities for further development of locations along the roads to facilitate economic or social activities.

The creation of a circular network of roads enable the establishment of the urban web (Salingaros, 1998) by providing access to multiple nodes and connections in the lower hierarchy, thereby enabling a multitude of movements through the system.

Fig. 6.13 New road network including internal and external connections
In order to support the creation of the circular road a hierarchy in the design of the streets will be introduced. As described on page 87, the roads will be build up including footpaths and swales to enable the drainage of the road surfaces.

Another major development is development of clear connections to the communities east and west of Tisous. The central points in Tisous created and highly connected towards outside sources enable the development of focus points in the development process for the development of socio-economic facilities.
SLOW INFRASTRUCTURE DEVELOPMENT

An integral part of the infrastructure network of Tisous is the creation of slow movement connections. These lines primarily function as spaces for slow movement (foot or bicycle) but also can accommodate a part of the water management structure introduced on the scale of the community.

The slow infrastructure lines are developed as part of the road network to enable a maximize the integration of these connections into the larger scale. The connections to the production locations creates the possibility to use the slow infrastructure lines for the creation of a Continuous productive urban landscape (Viljoen et al., 2005). The network of green spaces through the community can be used for production of for instance fruits. Beneficial to the development of these continuous green lines is the local climate. The greening of the urban landscape can influence the urban heat island effect and is capable of retaining water in the case of heavy rainfall.

The slow infrastructure is developed to support the use of the outdoor spaces by the community. The interlinked character of these spaces provide a clear network for slow movement. A part of these connections are designed as stairs, including flat surfaces for recreation to cover the vertical transport inside Tisous. The landscape in Tisous requires the development of vertical transport possibilities. This upgrade of the slow infrastructures provides such a potential.

Fig. 6.16 Schematic overview of slow infrastructure
Fig. 6.17 Slow infrastructure connections to be developed
WATER LINES

The network of water connections being developed for Tisous is developed to support the existing water lines present in the community. Based on the natural flow of water the water streams, one additional water stream is developed. At the same time is based on the topography of the community in combination with the road network a drainage system created to support the water management inside the community.

In combination to the slow infrastructure lines, the drainage system will be used for the filtration of the water, before the water enters the main water streams. In the water stream itself the water will be filtered for a second time to purify the water so that it can be used inside the washing facilities, which can be the link between the water lines and the production locations.

Fig. 6.18 development of water lines + drainage
WATER DISTRIBUTION

A major aspect of the water management is the provision of potable water for the community. Therefore a system of distribution points inside the community is planned. Each of the distribution points has an service area of 200 meter.

The distribution points can be combined with waste collection points to strengthen the waste collection and combine it with the need for potable water.

These locations are an indicator of the location for the distribution points. The exact location of the distribution points can be determined depending on the final layout of the individual housing plans.
SOCIO-ECONOMIC FACILITIES

The socio-economic facilities created as an integral part of this development will mainly be used for the development of washing facilities that support the quality of life inside Tisous.

Located on or next to the production location and in connection to the water streams, the washing facilities have access to patches of open land that can be used for the first filtration of the grey water produced inside the washing facilities.

In the centre of the community, where multiple roads come together a location for community activities will be created to support the development of social facilities. For instance community centre and sports fields can be developed at this location. The high level of connectivity in all directions makes the location also suitable for the development of small economic activities.

Fig. 6.20 Location of socio-economic facilities
Fig. 6.21 Overall development vision for Tisous
Translating the development vision for the Tisous community into spatial interventions that visualise the implementation into the community. The housing developments designed form a part of overall network part of the strategy. The integration and connections of multiple functions are showed.
7. INTERVENTIONS & IMPLEMENTATION

7.1 URBAN INTERVENTIONS
7.2 HOUSING DEVELOPMENT
7.3 HOUSING DESIGN
URBAN INTERVENTIONS

The creation of the development vision for the community of Tisous needs to be translated into a design of the community that can be used for the development of specific interventions inside the community. These interventions will support the developed vision through the use of design principles created as part of the development strategy.

In combination with the existing urban fabric of the community, the principles are used to form the building blocks that can be designed and further worked out by design specialists in combination with the community and its CBO.

The first intervention designed is one of the housing developments. Located along the main circular road, the location has a good connection with the rest of the community. The development of this project can work as a testcase before the complete vision will be implemented into the settlement. The different technologies proposed can be tested and the community can be educated on the proper use of these advances.

Fig. 7.1 location intervention in Tisous
7.2 HOUSING DEVELOPMENT

**Green blue lines**

The first spatial intervention is the creation of a green blue line. The connection of the slow infrastructure lines in combination with the water management lines create a green blue line. The space required for this line is 6 meter. 4 meter for the water line and 2 meter for fixed pedestrian paths. Depending on the pressure on the drainage capacity the width of the blue line can change, creating more and less green space for public use. The greening of these lines is an important aspect that supports the greening process of Tisous.

**Connections to main infrastructure**

To increase the level of connectivity of the spaces that will be developed as part of the larger strategy for the whole community, multiple connections will be created. These connections will increase the possibilities of movement inside the new development.

**Wind cooling**

The most common wind in Haiti is the eastern wind. The enable the wind flowing through the new development east-west corridors are introduced. These corridors will be designed as green corridors that enable the wind to flow through and create passive cooling effects.

The corridors are located to create a possible connection with the main infrastructure. During future developments of the community, these corridors can be expended, thereby creating a better link to this development.
7.3 HOUSING DESIGN

The created pattern of connections forms the basis for the development of the housing plans created in the development strategy. The developed road network forms different patches of connected lands that will be used for the housing developments. All the functions included in the housing development, described in chapter 4.6.3 are integrated into these plots.

The different blocks are build up out of multiple housing plots, sanitation units and the water filtration system for the first filtration of the domestic grey water. The overall water management system is included in this scheme to involve these developments into the general development vision for Tisous.

The main drainage line in this development is the central green line that is developed as a green-blue line usable for the filtration process of domestic grey water and the water collected in the swales integrated in the new road structure. This results in the creation of a strong green-blue line through the whole development, forming a backbone of the whole development.

The green-blue line developed is also the main public space inside this development. Although the line can be flooded during heavy rainfall, if dried out, it forms a strong green link through the settlement. The green character supports the urban greening process that is an integral part of this strategy.

The development of the different patches of housing development in combination with the unsymmetrical street pattern results in the creation of multiple small open space inside the development. These spaces will be developed as communal grounds for in the form of small playgrounds and pocket parks to strengthen the settlements upgrading process and the beautification of the urban environment.

At the end of the green-blue line, an small wetland is constructed for the final filtration of the water before it enters the canal. This wetland filtrates the water coming from the roads and households inside this development.

Fig. 7.3 Intervention in its context
The development of the housing incorporates the sanitation and grey water filtration inside its compound plus the temporary storage of non-potable water collected on roofs.

The green spaces inside the housing blocks will be fitted out with rain gardens that capture and filters the domestic grey water. The output of the households directly flows into these rain gardens laid out as a horizontal flow wetland. The water flows through the plants to filter after which it can flow to the green-blue lines.

Based on the households domestic non-potable water use, the size of the storage tanks have been calculated. The storage capacity is determined as can be seen in figure 7.6.

The development of these basic facilities inside the housing blocks enables the further development of the housing plots by the community itself. They are responsible for the development of the individual households, with the technical support from professionals that are part of the development team.

<table>
<thead>
<tr>
<th>Month</th>
<th>Average rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>33 mm</td>
</tr>
<tr>
<td>February</td>
<td>58 mm</td>
</tr>
<tr>
<td>March</td>
<td>86 mm</td>
</tr>
<tr>
<td>April</td>
<td>160 mm</td>
</tr>
<tr>
<td>May</td>
<td>231 mm</td>
</tr>
<tr>
<td>June</td>
<td>102 mm</td>
</tr>
<tr>
<td>July</td>
<td>74 mm</td>
</tr>
<tr>
<td>August</td>
<td>145 mm</td>
</tr>
<tr>
<td>September</td>
<td>175 mm</td>
</tr>
<tr>
<td>October</td>
<td>170 mm</td>
</tr>
<tr>
<td>November</td>
<td>86 mm</td>
</tr>
<tr>
<td>December</td>
<td>33 mm</td>
</tr>
<tr>
<td><strong>Total average</strong></td>
<td><strong>1353 mm</strong></td>
</tr>
</tbody>
</table>

Average/ month 113 mm

Fig. 7.5 Average annual rainfall in Haiti
Last step in the development of this thesis is the conclusion and reflection on the project and the implementation of the strategy in the Tisous community.
8. CONCLUSION + REFLECTION

8.1 REFLECTION
8.2 CONCLUSION
8.3 DISCUSSION & RECOMMENDATIONS
8.1 REFLECTION

The reflection of the process is an essential part of this thesis to conclude the hypothesis stated in chapter 3.5. The strategy developed is part of a long-term development process. Therefore it is not possible to test the strategy in real-life situation to check the possibilities of implementation and involvement of the community in the redevelopment of their community. To overcome this situation the main aspects of this thesis are reflected:

- Local development framework
- Empowerment of the community
- Development and linking of basic functions
- Upgrade of the settlement
- Food production process

Local development framework

- Is the local development framework a viable option for large scale development project?

The local development framework is advocated by the World Bank as one of the approaches of development in developing countries. Enabling development of the urban poor communities can not be organized from the top. The implementation of the Local Development Framework can be a difficult process during which the different stakeholders need to be acknowledged and made accountable. The recognized multiple difficulties of scaling up withhold the implementation of Local development framework on the scale larger then one community are (Binswanger-Mkhize et al., 2010, 77-79):

1. Hostile institutional settings, the existing political powers might not be willing to chance their positions. Laws and policies might not allow the community support by external sources e.g. NGOs.

2. Total costs, fiscal costs, or both may be too high. Although the costs of involvement of local stakeholders might not be expensive, the development of larger scale project, province or national, could be to expensive.

3. Difficulties arising from co-production may not be mastered. The complex cooperation between the large number of stakeholder, all with their own needs and demands can result in conflicting demands of the stakeholders. This can slow down the process or even result in negative results.

4. Adaptation to the local context may be missing. The differences in character between multiple communities does not allow a precise replication of successful projects. Each community is different and has its own needs and urgencies.

5. Scaling-up logistics may be lacking. The infrastructure that needs to support the development of a large number of local development projects is missing.

- Can the local development framework be applied in Haiti?

The difficulties of implementing local development project depend on the willingness and capacity of all the stakeholder, making it a vulnerable approach towards development. The need for strong support can be one of the aspects that withholds the implementation of this approach in Haiti. The poor capacity of the governmental bodies.

The involvement of a growing number of participants in the can influence the level of participation, especially of the groups with weak voices. Therefore it is important to support the community involved if they do not have experience with the participation in the processes.

The focus of the development is depending on the participation of the stakeholders. The stronger the voice of one group, the more focus they get during the development process. The equality of participation is therefore an important aspect during the whole process.
Although the use of a local development framework enables bottom-up development and the inclusion of communities in planning processes, the implementation can be difficult and maybe even not feasible in the real life. The need for strong support of different stakeholders on different levels of governance and the private sector are points that are not strongly represented in Haiti. The use of a local development framework in Haiti needs further support with for instance a shift in the urban planning approach the whole country is not using at the moment. Next to that, the development of community depends highly on the stability on political, economic and social structures in Haiti. The high level of uncertainty on these aspects make the predictability of success impossible, making the start of these projects even more difficult.

**Empowerment of the community**

- **Is the community involved in the development of vision for the specific settlement?**
  Organising the participation of the community is of vital essence for the development and implementation of the strategy. The inexperienced communities need to be actively supported in order for them to become an integral partner of the development process. The weak position they are having presently exclude them from the planning process and for them to be able to participate they need to be educated and empowered. The upwards accountability of local governments can strengthen this voice.

- **Can the community be seen as an equal partner in the development process?**
  The strengthened position and active participation in the planning process in theory enables the empowerment of the community. In combination with the development of local social and economic structures inside the community to run the agricultural production the social capital inside the involved community will be strengthened.

- **What is the role of urban agriculture in the empowerment of the community?**
  The development of urban agriculture is of importance for the enabling of this process. The need for communal cooperation for the collection of waste, composting and production of foods requires a high level of cooperation between the community members. This cooperation can strengthen the social networks and create social safety nets that can help in restructuring the community after another crisis. The strengthened social capital in the community also enables a better implementation of the developed development vision.

The test case of Tisous has not been developed in cooperation with the local community. If the community was involved in this project, the result would most likely have been different in term of needs and urgencies. The need for the community to participate in the development process is of great importance to test the potential implementation of the vision. Not just for the test of the technologies and facilities advocated in the vision, also the development, use and maintenance depend on the level of acceptance by the community.
Development and linking of functions

- **What are the results of linking different functions?**

Supporting urban development inside the marginalized settlements found depends on many different problems found in these areas. Most of the most urgent needs cannot be covered by the development focusing on just one sector. The multi-sectoral approach is needed to overcome the problematic situation inside communities. For instance, building hospitals alone does not improve the health situation of the community. A integral approach towards the improvement of health care, nutrition, water security, and education combined does help in improving the health situation.

The multi-sectoral approach that is one of the foundations of the development strategy enables the integral development of the basic needs. Although the technical combination requires a high level of cooperation between the stakeholders of the different sectors involved in the process.

- **Does urban agriculture strengthen the linking of functions?**

The addition of urban agriculture to the network does enable a further integration of the different functions into an also productive network of functions. The potential benefits of this network can help to overcome the most urgent needs in the post-disaster moments. Next to that, the development of the basic facilities do support the level of human development and even incorporates on parts of the Millennium development goals, set by the United Nations (United Nations, 2010). The network of functions, including urban agriculture require less external resources for production of foods. The main required products, water and fertilizer are produced inside the community. The reuse of natural resources strengthens the outcome of the overall project. The concerns about the state of the world’s natural resources and productive lands worldwide require a demand a review of the current use of both land and resources. Combined with a world’s food crisis waiting to happen, the potential production inside urban areas strengthens the resilience of the community and its surrounding urban area. The decreased demand for resources is an important aspect in this.

- **Is the linking of functions a generic solution for the (re)development of informal settlements?**

The developed links between the basic urban functions on page 67 is the general version of the functional network. Depending on the local characteristics, the exact layout and functioning of the connections can differ. For instance, the integration of a complete ecological water filtration system can, most likely, not be developed inside dense urban environments due to spatial conditions. For these spaces, more confined solutions need to be developed. In the case of Tisous, the general diagram has been translated to the possible implementation in the community, as can be seen on page 121.
Upgrade of the settlement

• Does the strategy provide a clear structure for the upgrade and inclusion of marginalized settlements?
The developed strategy is based on international accepted theories (Salingaros, 2005) on the development of urban environments. The structure of different elements that together form an urban web structure enables the development of a clear structure. The web, consisting out of nodes and connections, enable the development of multiple patches of land that all have their own function and hierarchy inside the network. The development implementation of the strategy can structure the often high level of anarchic constructions inside informal settlements, thereby enabling an upwards development cycle. The structure developed in the strategy can be applied in other urban environment as well. Depending on the local availability of spaces for the different aspects, the network can be build up to enable the development of the settlement.

• Are the planned upgrades sustainable?
The linking of functions and the development of the urban web structure do support sustainable lifestyles. The principles of permaculture (Mollison, 1988) are incorporated in the development strategy. In combination with the application of environmentally strong technologies for the use and reuse of natural resources, more sustainable lifestyle are enabled. The development of slow-infrastructure connections is one of the examples in this. The development of interconnected green spaces promote walking inside the community. The incorporation of green elements in these connections contribute to the quality of these public spaces, encouraging its use.

• How can the strategy be expended to increase its potential classification of the land?
The next step in the implementation of this strategy can be the development of a structural system to analyse and classify the land inside the community. Currently the urban web structure is build up out of six elements, of which three are spaces of human activity.
Food production process

- Can agriculture be incorporated in urban settlements?

Urban agriculture is a suitable addition to the urban environment. The many benefits food production can have on the urban environment are described in chapter 3.2. More important is the creation of possibilities for urban production. Although recognized as a valuable landuse, urban agriculture is often forbidden by policies and politicians. The stigmas on urban food production such as potential health risks prevent project from starting. If developed in the right ways and under the supervision of experts, especially in the use of chemicals and breeding of livestock, urban agriculture does not need to become a health risk.

- What is the contribution of the food production to the community?

The production of foods and the yield that can be gained of urban production is highly dependent on many different aspects. The potential production in this thesis is therefore just a rough assumption. Some of the factors that influence urban production are:
  - Soil conditions,
  - Use of chemicals,
  - Knowledge on production methods,
  - Crop calendar,
  - Crop rotation

To calculate the contribution of food production is therefore impossible based on the knowledge available in this thesis. An agronomist with the knowledge of the local ecosystem, production methods etc therefore needs to be included in the project team to enable the development of strong agricultural production fields and train the community.

- On what aspects does the production of foods depend?

The main aspects that can be provided through the implementation of this strategy are soil, water and fertilizer. These three enable the possibility of urban production and can be provided through the arrangement of the urban environment as provided in this thesis.

Next to these aspects is the urban production depending on the performance of the farmers themselves. Haitian farmers need to be trained as part of the implementation of this strategy. Not just in the production of foods, also the composting process and the safe use of urine as fertilizer require training.

Another aspect that needs to be developed during the implementation of the strategy is the process of waste collection and composting. The use of human waste for production needs to done by great care to prevent health risks due the pathogens inside human waste.

The training and testing of the different technologies advocated in this thesis can be one of the tasks that involved the Community Based Organisation. It can be their task to organise trainings in cooperation with different experts.
The goal of this thesis was the formulation of a development strategy that enables the integration of urban agriculture in the bottom-up development process during which informal settlements can be developed into supportive urban landscapes that do not disable the community from participation in the daily urban systems.

**January 2010, the opportunity for urban redevelopment.**

The economic, social, and institutional situation of Haiti before the earthquake was already among the least competitive in the world. The post-disaster redevelopment process offers a unique opportunity for the reassignment of the powers inside Haiti. Through the application of the local development framework bottom-up developments can be started for the integral development of settlements and their communities. For the enabling of development depends on many different aspects. One of the main aspects is the availability of basic facilities to support the quality of life inside the marginalized settlements.

By structuring a development vision using three main steps a Community Action Plan can describe the development process. As first it is the integration of the basic facilities, WASH, infrastructure, water management, etc. into a complete functional network. The integration of urban agriculture into this functional network enables the use and reuse of water and both human and organic, in the production of foods. The creation of this system reduces the need for external resources and advances the metabolism of the community. Instead of using only external resources to satisfy the needs of the population, local produced foods influence the levels of foods security.

Second step, the formation of urban web structures that transforms the functional links created into spatial interventions in the settlements. The use of the urban web structure, promoted by Salingaros (2005) enable the development of strong spatial configuration of the settlement that support the development of the community.

As tested in Tisous, both steps can lead up to the formation of a interlinked network of spaces and functions in the settlements layout. This process makes the urban environment supportive to the community through the availability of the needs for urban lifestyles in form of local sanitation, water management, food production and waste recycling.

**Development framework**

In order to be able to implement the developed strategy into the community it is of great importance to have all the stakeholders, working together to create the most benefit for the community inside the project area. The inactive national government is not capable of providing the development potentials towards the population in highest need of development. To overcome this situation, the community will be empowered as one of the partners in the development process. Through the enrolment of the local development framework, the combined approach on community support, local governance, and decentralized sectorial, is implemented on the scale of the commune to restate the development process in Haiti in this post-disaster situation.
Impact of urban agriculture
The development of the strategy and the enabling of potential agricultural production inside informal settlements can have many benefits on the community. Implementing urban agriculture inside informal settlement not just influences the availability of foods. It can help in the implementation of environmentally strong technologies that support the level of sustainability of the community. The application of green technologies for the filtration of water can help upgrading the quality of the urban landscape as is developed for the community of Tisous. Instead of the development of costly sewage systems that can not be connected to central filtration facilities, local filtration through rain gardens and wetlands prepare the water before being used as irrigation water on the productive grounds.

The framework developed enables an overall development that integrates the many different needs of the communities into one development vision that needs to be developed and implemented with and by the community in cooperation to all other stakeholders that have some level of interest in the different development programs.
8.3 DISCUSSION & RECOMMENDATIONS

Discussion
The complexity of this project opens the possibility for discussion on the content of this thesis. The general objectives of this project and the master this thesis is part of do not fully allow the full research and understanding of subjects touched on during this project.

Development framework
The local development framework is used as the basis for bottom-up development of the communities. Although the approach is advocated by the World Bank and have been build up out of the combination of three worldwide tested approaches, it is more then just a framework that can be replicated elsewhere. As a spatial planner, the knowledge on parts of the development strategy are missing. Therefore, the use of this framework should be seen as a stepping stone to connect the spatial development advocated in this thesis with the development on the larger urban scale. In the case of Haiti, the transformation of developing processes is influenced by many different factor, of which some, surely, are overlooked.

Another aspect is the presence of risk management. Large parts of Port-au-Prince are unsuitable for occupation. Before communities can be upgraded it is important to research potential hazards.

Urban production possibilities
The benefits of urban agriculture stated in chapter 3.2 offer the opportunity to start believing in the potentials. It must be stated that agricultural production is a difficult process. The strategy developed therefore focuses on the enabling of possible production, it is not researching the actual production itself. The knowledge on this field is missing and therefore it can create misleading images on the impact of the productive grounds.

Recommendations
The strategy developed in this thesis can be a first step towards new vision of the impact of integral redevelopment processes in post-disaster situation. For further research there are several recommendations to be made.

• The bottom-up development of informal communities through the use of the local development framework need to researched, mainly on the roles of the different stakeholders.
• Before the upgrading process of marginalized settlement should be started it is important to research the potential hazards. This can lead to the need for relocation of the community or chances in the layout of the settlement.
• Agricultural production is a science in itself. The integration of production therefore needs to be researched.
• The technical possibility of linking the functions should be further investigated. Mainly the water management and filtration of water is a delicate task. The potential health risk of reusing water and waste are important.
• The institutional support in Haiti is assumed weak. The shift needed for the local development framework needs to be studied and supported.
Banana tree (photo by L. Smits)
9. APPENDIXES

A | BIBLIOGRAPHY
B | REFLECTION ON GRADUATION


Enagic future Haiti | Msc Thesis Peter Arnts


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Working in a situation unfamiliar to myself and most people in the faculty proved to be sometimes difficult. Not just the unfamiliarity with the context in Haiti but also the structure of the studio was something else then the usual.

Project structure
At the start of the project, many uncertainties in were still present. Not just the trip to Haiti was unclear if that was going to happen. Also the lectures were often improvised. Although most of them were interesting and relevant to the project there was no clear build up of information. The unfamiliarity with the Haitian context made it difficult to get a grip on the start of the project.

The influence of the mentor team on the progress during this project was big. At start, the support was minimal, making it sometimes difficult to get a grip on the project structure itself. After the shift in the mentor team, the structure was brought back into perspective. This chance helped in bringing the project back on track and to get a reasonable final product.

Project planning
The structure of the project relates to the planning of the project. Directly after the start, the group work was neglected by all members. The importance of group work was missing, resulting in a only partly finished product that was not used afterwards. The trip to Haiti is another part of the distorted planning. At the start of the project it was stated to go to Haiti during the summer months. In the end it was October when we arrived in Haiti. This change in dates also shifted the focus of the project partially. The long uncertainty of the trip caused several small changes in the project approach. After the trip the project was changed one more time. The scale of intervention changed from the city-wide scale to the community.

The experiences in Haiti changed my perspectives on the possibilities of this project.

Relevance of the project
This project were my first experiences with many field touched upon in this project. The new context, the planning framework and the world of urban agriculture required a large expansion of my knowledge and visions. By gathering all this knowledge it sometimes was unclear if the proposals can actually be implemented into the real situations. The theoretical basis of this project is present. Only question remaining is the potential of the use of the strategy in real situations and by real stakeholders. There are many uncertainties that need to be covered before this project can be used by ngo’s or governments for instance. The developed approach is a interesting approach to the development of communities, but needs further clarification.