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Peri urban agriculture in Casablanca

- A multifunctional solution to a sustainable urban food supply?

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- En multifunktionell lösning för en hållbar urban matförsörjning?

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Abstract

The urbanisation in the world today is at its highest pace so far in history. More than half of the world's population is already living in cities. In the developing countries the cities and mega regions are expected to grow in the coming decades (United Nations, 2014). With the growing metabolism of these mega regions in terms of food consumption, waste handling and infrastructure solutions, the pressure grows on urban planners and politicians to adapt and design the cities for the growing needs of its inhabitants (FAO, 2006). Instead of strictly separating the agriculture and the city, a more desired path today is to incorporate some of the cities food production within the city and its peri urban proximity. Small-scale ecological agriculture or agroecology has shown to be one model that fits this criteria of urban agriculture, in favour of large scale monoculture agriculture that is less compatible in an urbanized context. This approach has shown to have many benefits mostly due to its multifunctional nature (Gliessman, 2006). Urban vegetation and agriculture can be used for cleaning storm water, handling heat island effects, serve as local meeting places and parks, add to the aesthetics of neighbourhoods, produce food locally with no transportation needs and many more. The positive effects of the urban agriculture approach for the city and its inhabitants have shown to be found in many areas: economic, social as well as environmental. Especially for the urban poor urban agriculture has proven to be beneficial. A challenge for UAs implementation as green infrastructure for cities is to prove its long-term benefits in favour of other land uses that have more market focused uses such as heavy industry.

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1. INTRODUCTION

Two of the most striking patterns of the world and the human civilisation of today are the rapid urbanisation and the destruction of the environment. It is in the search for a better life, that millions of people in the developing world migrate from the rural areas to the cities, which in an increasingly faster pace transforms into mega regions. In 2008 more than half of the world's population (3,3 billion) lived in cities and by 2030 this number is estimated to be 5 billion (United Nations, 2014). Today the most rapid urbanisation is occurring in developing countries. Many of the urbanities will be poor, and it is up to the decision makers of today to plan for this population growth. As these mega regions grow, the urban overlap the rural, and claim the agricultural land where the high quality soil is (Gliessman, 2006). "Maintaining the food security of the rapidly growing urban populations, particularly the poor, will be one of the greatest challenges of the 21st century" (FAO, 2006). To sustain the growing urban populations it requires a steadily growing stream of natural resources from rural areas. Therefore the ecological footprint of the city requires land hundred times larger than the area of the city itself so sustain itself (Moffat, 2000). As conventional agriculture with its rather high dependence on oil, high use of fresh water, chemical fertilisers and pesticides is one of the main contributors to the degradation of the environment, a complementary model of sustainable urban food production could be well at hand (FAO, 2015).

This thesis builds on the experiences from a MFS in Casablanca Morocco, and aims at exploring the role of urban agriculture as an approach for solving some of the problems associated with the rapid urbanization. The aim is to explore how small scale peri urban farming by agroecological methods in Casablanca can contribute to a sustainable urban food supply and also being multifunctional.

MFS: Minor Field Study. MFS is a scholarship program for field studies in developing countries granted by SIDA the Swedish bureau of foreign aid. The scholarship is granted to students to do their candidate thesis during 8 weeks in the country being the focus of their thesis.

1.1 UNSUSTAINABLE FOOD PRODUCTION AND THE RAPID URBANISATION

Conventional agricultural methods are recognised to be efficient in its capacity to produce large amount food by the use of highly technical machines and other means, but this form of agriculture is also highly dependent on oil and fresh water. Of all freshwater used today about 70% is used for agriculture. (Postel and Vickers, 2004). By its monofunctional nature, conventional agriculture will contribute little to other functions that are highly desired, such as ecosystem services, recreational etc, in the context of the city or peri urban areas (FAO, 2015). Often the food is produced a long way from the consumer. In low income countries the losses in the food distribution chain can be between 30-50% before the food reaches the market, this is mostly due to long transports and lack of cold storage. By local production this loss can be kept at a minimal (Vinnerås & Jönsson, 2014).

By the use of intensive tillage and monoculture plant material, pesticides and fertilizers the soil is constantly degraded. This could in the long run result in degradation in soil quality, which is affected by wind and rain erosion because of low organic material and cover crops (FAO 2010). The use of single crops (monoculture) makes the crop more vulnerable to pest attacks. It also favours a few, often times genetically modified or transgenic (GM) variety's, which threatens natural and local varieties and contributes to the loss of genetic diversity. Synthetic fertilisers used in conventional agriculture are often leaked from the fields and into the groundwater or lakes where it increases algae and contribute to anaerobic conditions.

Between 5-7 million ha of soil is lost globally due to soil degradation as a result conventional agricultural practices. In Africa the erosion rate is 5 -10 tons/ha of lost soil per year. This is to be compared to the rate that soil is created of 1ton/ha per year (Gliessman, 2006).

Conventional agriculture is the largest contributor to the pollution of the water. The pollutants include pesticides, herbicides, fertiliser, animal waste, salts and other agrochemicals. The option of cultivating more land is also not possible since most of the agricultural land on the earth already has been covered by human use (FAO, 2010).

This intense, large scale and mechanised way of farming makes conventional agriculture less multifunctional and compatible with desired functions such as recreational, ecosystem services, social services etc. (Gliessman, 2006). It is now widely acknowledged that identifying sustainable urbanizing strategies (ecological, social and economic) is a key factor for global sustainable development. (Camhis 2006; Clark 2007; FAO, 2008)

“..Partly due to the rural decline, the world is urbanizing at a fast pace and it will not be long before a greater part of developing country populations is living in large cities. Therefore, urban food security and its related problems should also be placed high on the agenda in the years to come.” Jacques Diouf FAO Director-General (FAO, 2006)

1.2 SMALL SCALE PERI URBAN AGRICULTURE

Many researchers argue that small-scale agriculture, urban or peri urban could be one solution for solving the problems posted by the rapid urbanization and the city's increasing demand for food. The concept of UA (Urban agriculture) could also counteract the strict separation of the urban and the rural. A desired path is instead to loose up this boarder between the urban and the rural. Urban or peri urban agriculture could provide food in a sustainable way and also be multifunctional, and serve as a green infrastructure for the city. One solution for solving the problems posted by the rapid urbanization and the city's increasing demand for food, could be the implementation of different forms of urban or peri urban agriculture (FAO, 2008).

Both in developed and developing countries, urban agriculture sets out to be a prominent strategy for solving the problems of malnutrition, poverty and to improve food security as well as provide recreation and ecosystem services (Wu 2006). There are many examples of modern great cities that have urban agriculture producing a great deal of the food it consumes. In Shanghai, China 60% of the vegetables and 90% of the eggs consumed by the city dwellers are produced within the city. (Bhatt and Farah, 2009) The “Victory gardens” and the urban agriculture in Cuba are examples of the resilience that urban agriculture creates in cases of chocks such as economic collapses or rising energy prices (Altieri, 1999). Urban forests can manage storm water run-off, increase property value by adding aesthetical values and also reduce the urban heat island effect (Konijnendijk, 2003). Agroforestry could other than food production also be combined with soil regeneration, biodiversity habitat and other ecosystem services (Garrity, 2004). Agroecological farming in and around the city can be combined with many other needs of its urban dwellers such as recreational, nutrient cycling, temperature buffering, increased biodiversity and many others. This way agroecological principles takes notice of sustainability in the fields of the ecology, social and the economical terms (Gliessman, 2006).

1.3 AGROECOLOGY

Agroecology is derived from the two different fields –ecology and agronomy and can be defined as “*The application of ecological concepts and principles to design and management of sustainable food systems*” (Gliessman, 2006). Where conventional agriculture is focused on the mechanization and maximization of one single crop by monoculture farming, agroecological methods aims at a diverse and multifunctional farming with different food crops and functions (Gliessman, 2006). Sustainability is central for agroecological farming and is described in terms of increasing soil fertility, maintain the soils ecological health, have minimal effect on the environment etc. The sustainability concept is even stretched to integrate social sustainability where one of its goals are to “*guarantee equality of access to appropriate agricultural practices, knowledge, and technologies and enable local control of agricultural resources*” (Gliessman, 2006) The challenge for agroecology is that it has to be both sustainable and productive. Agroecology is more focused on small scale farming and community and is therefore challenging the concept of conventional large scale monoculture food production (Gliessman, 2006). The natural flow of resources is central in agroecology, where the aim is to design systems where this flow mimics nature as much as possible.

1.4 MULTIFUNCTIONALITY

The aspect of multifunctionality is central for agroecology, and many of the concepts above can be combined to create what could be called an urban food forest system (UFF). “The intentional and strategic use of woody perennial food producing species in urban edible landscapes to improve the sustainability and resilience of urban communities” (IAASTD, 2009). The emphasis in this system is the focus on fruit bearing and nut-producing food trees. Many researchers are emphasizing the use of the multifunctional urban landscape. Landscapes that can simultaneously integrate multiple ecosystem services, erosion control, climate regulation, food production and social services (Lovell and Johnson, 2009). These urban multifunctional landscapes can for example integrate storm water retention and bioremediation(biological breakdown of contaminated soil etc) with the aesthetic and educational aspects of designed environments. This approach makes the landscape more resilient and also improve human well being (Lovell and Johnston, 2009).

Definition by OECD (Organisation for Economic Co-operation and Development): “Beyond its primary function of producing food and fibre, agricultural activity can also shape the landscape, provide environmental benefits such as land conservation, the sustainable management of renewable natural resources and the preservation of biodiversity, and contribute to the socio-economic viability of many rural areas. Agriculture is multifunctional when it has one or several functions in addition to its primary role of producing food and fibre.”

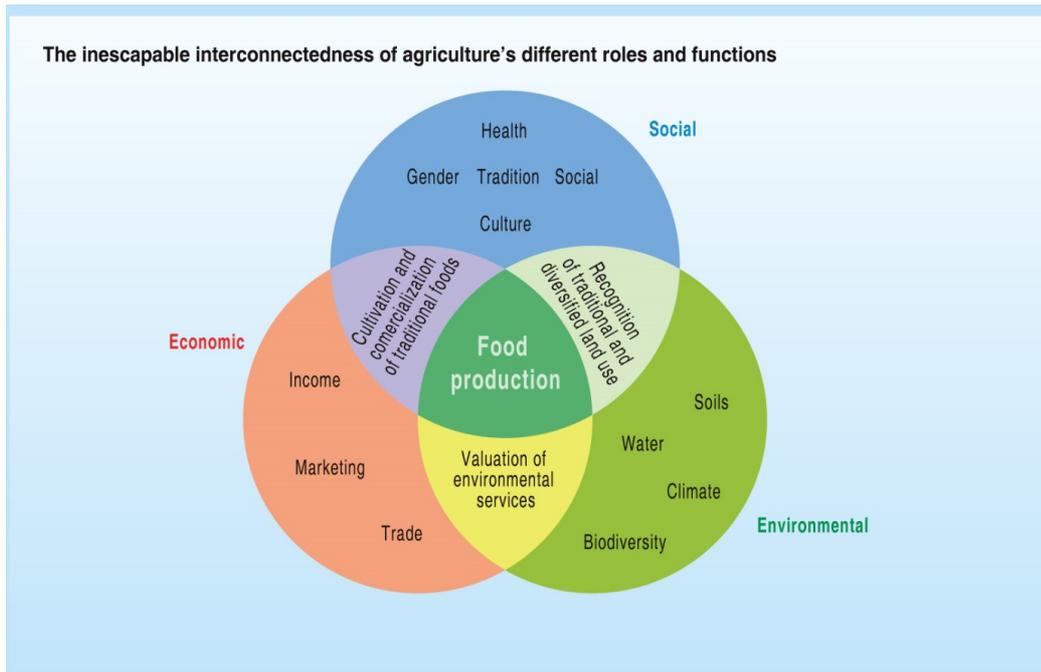


Figure 1.
A venn diagram describing the possibilities for a multifunctional food production on its three pillars: Social, environmental and economic “A multifunctional perspective of agriculture” (IAASTD 2008)

2. AIM AND OBJECTIVES

The aim of this thesis is to explore the possibilities of peri urban farming as a contributor to a sustainable food supply for the city, and if it can have a multifunctional role as a part of a green infrastructure. I also want to investigate the driving forces behind small-scale peri urban agriculture, from a user perspective. This thesis will also explore if and how, an existing sustainable agriculture system, located in Morocco can be used as an inspiration for UA.

The farm in Casablanca being a pilot project within the currently ongoing UAC project (UAC: Urban agriculture project Casablanca. An urban planning project collaboration between German and Moroccan universities). It is a process not fully evaluated at the present time, and it is also the purpose of this thesis to share the experience and conclusions gained so far in this process.

2.1 QUESTIONS:

- How can peri urban agroecological small scale agriculture contribute to a sustainable urban development and a sustainable food production?
- What are the driving forces behind small scale peri urban agriculture?
- How can sustainable rural agriculture in Morocco (Inraren) serve as inspiration for UA?

2.2 LIMITATIONS

This thesis is primarily in the small scale. The bigger scale and the overall complexities of urban development is merely touched on in this thesis, other than for putting the small scale farm into context. Any deeper analysis in the economics and technical aspects for UA are also left outside the focus of this thesis.

3. MATERIAL AND METHOD

This study is based on a literature study and a field study. The literature study is primarily based in the background part of this thesis, where it serves to explain definitions and to create a theoretical background of UA. The literature study is based on books and articles about agroecology and urban food forestry, and from articles about the UA project in Casablanca. The introduction book "Agroecology" by S.Gliessman is primarily used for the purpose of explaining agroecology and sustainability. Articles about "urbanisation", "sustainable development", "multifunctionality" "urban food forestry" etc is used for setting the background, and a more general view on the problems associated with urbanisation and sustainability. Most of the information regarding guidelines for sustainable agriculture is derived from databases such as FAO (food and agriculture organisation of the UN) and globalagriculture.org. Articles specifically regarding the urban agriculture project published by the research groups have also been studied for this thesis. The field study is primarily based on qualitative interviews, and semi structured interviews for the purpose of understanding the driving forces and possibilities of UA. Visual observation and photo documentation as well as participatory observation during actual work at the farm were also methods used for gathering data for this thesis.

3.1 FIELD STUDY: FATOUMAS FARM, CASABLANCA

The primary location for the field study was Fatoumas farm in Dar Bouazza, Casablanca, Morocco, where I also lived for a period of two weeks. Dar Bouazza is located in the peri urban areas of south west Casablanca, 20 km from the city's centre. The reason for choosing this location was because it is an agroecological farm and also for being being a pilot project within the UAC project. The area is currently going through a new face of development, as it is both inhabited by the poor and more recently by the more wealthy people of Casablanca who are building luxurious houses in the area, and thus the area is the target of land speculation.

The farm being my primary study location during my field study, I also had the opportunity to explore the more central parts of Casablanca and the connection between the urban and the rural. The field study will also investigate multifunctionality and the possible role that UA could have in a new green infrastructure for the city. The field study is consisting of: Qualitative and semi structured interviews, participating observations and visual documentation. The driving forces behind small scale UA will be explored by interviews, and first hand observations of the daily routines at the farm in Dar Bouazza.

For the purpose of exploring a sustainable agricultural system that is multifunctional and currently in use in Morocco, that can serve as inspiration for UA, a field trip to the food forest in Inraren was included for the field study. The food forest is used as a reference site for the field study.

3.2 REFERENCE SITE: INRAREN FOOD FOREST, ATLAS MOUNTAINS

The village of Inraren is located in the Atlas Mountains, 50 km from the Atlantic ocean near the city of Agadir. What makes this food system interesting is that it is estimated to have been cultivated for over 2000 years, with no input of external fertilizer. For one week I stayed in Inraren located in the Atlas Mountains near Agadir together with another student from SLU, Alnarp (Axel Wendt). For that period we tried to eat as much as possible from what was locally produced in the valley. We also obtained an inventory of the most abundant food species found. Documentation was done by photo and interviews by local farmers.

3.3 INTERVIEWS

Interview has been a central method for gathering information for this thesis. For sharing first hand personal experiences from local farmers etc, not available in literature, interviews was the obvious choice. The interviewed persons for this study were chosen for their involvement in the UAC project. For this reason, planners, landscape architects in the UAC project, the farmers and the owner of the agroecological farm in Dar Bouazza were chosen to share their experience of the project. The interview method used for this thesis is qualitative and semi structured qualitative interviews (Kvale, 2008). As described about this method, much emphasis was taken to let the interviewed subjects feel relaxed and comfortable during the interviews. The interviews were conducted both with one person at a time, and in groups. The central themes for the interviews revolved around the questions for this thesis such as “ what are the driving forces behind small scale agriculture” etc. Other guiding themes such as “UA as a green infrastructure”, “multifunctionality” etc were also guidelines for the interviews. The interviews took around one hour or less. Less formal interviews during my work at the farm also contributed to the material used for this thesis. The interviews were documented by note taking. Afterwards they were analysed and structured according to some of the themes and of its relevance to the questions of this thesis.

Interviews were conducted with the following:

Juliane Brandt, UAC research team, landscape architect, Berlin, Germany

Fouad Amroui, UAC research team, Professor in hydrology, Casablanca, Morocco

Fatouma Benedich, owner of the agro ecological farm in Dar Bouazza, Casablanca, Morocco

Allal, head gardener at the Agro ecological farm in Dar Bouazza, Casablanca, Morocco

Abdallatif, agro ecological grower and member in the corporative for agro ecological growers in Dar Bouazza, Casablanca, Morocco.

Farmers in Inraren food forest (group) Inraren, Morocco.

Interpreter

The first language in Morocco is Arabic and the second is French. In the rural parts of the country the language Berber is also common. The interviews were made both with and without an interpreter, as sometimes English could be used. The same interpreter were used throughout the study.

4. CASE BACKGROUND



Figure 2. Casablancas location in northern Morocco (Google maps 2015).

4.1 URBANISATION IN THE REGION OF GREATER CASABLANCA

The Casablanca region is the largest urbanised region in Morocco with approximately 4 million inhabitants, and an average population growth of 2.3%. 40% of the population is younger than 20 years old. In 1997 the “Greater Casablanca” region was created (see figure 3), which today is the country’s economic and finance centre where 60% of the Moroccan industry is concentrated. The region also has one of Africa’s largest harbours. The region is today facing the consequences of rapid urbanisation. This has led to a dynamically expanding and a poly centric city without coherence between some of its parts. It has also led to an increase of informal settlements and the creation of poor quarters, so called “bidonvilles” where the living standard is very low in regards of housing, water, fresh food and sanitary conditions. As the city grows the rural parts are overlapped by the urban. New housing complexes are being built on former agricultural land when the city borders are expanding. Intense land speculation is a big problem, as it often leads to the cessation of agricultural production in peri urban areas (UAC, 2011).

58% of the soil in the region of greater Casablanca (see figure 3) is regarded as soils with good agronomic value. The soil in Dar Bouazza is graded the second best and has traditionally been used for vegetable cultivation. The total land used for agriculture in the region of greater Casablanca is currently 67 874 ha or 58% of 117,398 ha. 8% of the agricultural area is irrigated (Amroui, 2013). The main crop cultivated in the greater region of Casablanca is cereals (69% of cultivated land), followed by fodder crops (20%) and gardening (9%) (Amroui 2013). The region is now facing the risk of land degradation as a consequence of the rapid urbanization and the fast growing city.

Qualité agronomique des sols

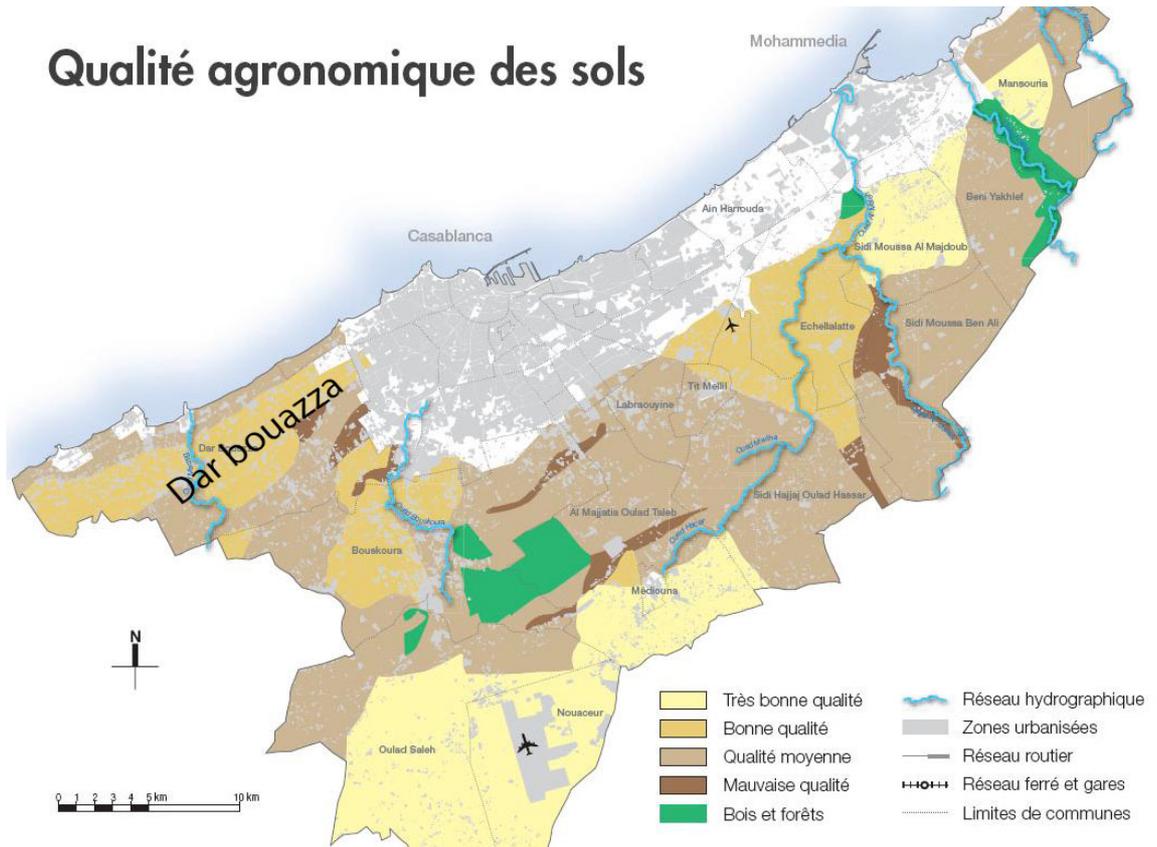


Figure 3. The greater region of Casablanca. The urbanized Casablanca in grey colour. Quality of the agricultural soils (Amroui 2010)

4.2 THE UAC

The UAC (Urban Agriculture Casablanca) is a German-Moroccan research project of the German Federal Ministry of Education and Research (BMBF) which is part of the megacity research programme "Research for the Sustainable Development of Megacities of Tomorrow". The focus is on energy- and climate-efficient structures in urban growth centres. The programme in Casablanca is one of ten on-going projects where bilateral research teams are researching the same topic of sustainable urban development. Some of the other projects are in Lima in South America, Johannesburg in South Africa and Hyderabad in India. One of the projects goals is to explore how urban agriculture can "be conceived as a strategic-conceptual and spatial approach in sustainable urban growth centres and mega-regions?". The project has a broad and experimental approach, rather than focusing on one solution, it has a creative way of trying out new solutions that can create positive synergies, such as when different uses are combined. It is believed that the use of urban agriculture both within the city and its rural parts can contribute to creating a multifunctional, climate optimized and sustainable green infrastructure where positive synergies can be created. The project will explore new forms of land use both within the city and in the rural parts and the hybrids between them. Currently there are four major pilot projects going on within the project in Casablanca (UAC, 2011). The agro ecological farm in Dar Bouazza is one of these pilot projects, and the focus for this thesis.

4.3 THE AIM OF THE UAC

The UACs approach for facing the problems of the rapid urbanization in Casablanca is to explore how new green infrastructure and UA can be integrated into the existing city. This is to counteract the current trend that the city grows uncontrolled and expand onto the fertile soils that surround it (figure3). Multifunctional urban agriculture is seen as an approach for solving the challenges of the growing city of Casablanca. The view of the researchers is that if peri urban agricultural land is to remain and survive the threat of land speculation, and not being absorbed by the growing city, it has to develop itself into a more multifunctional form of agriculture and create synergies with the city. Some functions that are suggested for peri urban and urban multifunctional agriculture are: contribute to the urban food supply, provide recreational and leisure opportunities, contribute to resource efficiency and urban recycling management, contribute to ecosystem services, integrate residential space functions and should be beautiful. Urban agriculture could be seen as having the recreational and leisure values of a park but is fundamentally different from parks in two ways by being both inhabited and productive (food) (UAC, 2011).

A question that remains to be answered for the project is how agriculture will profit by being part of the city. The integration of UA as new sustainable infrastructures, strongest contribution is believed to be from public health gain associated with outdoor activity, fresh fruits and vegetables, closed waste system and a greener city. UA is also expected to increase the resilience of the city, as it becomes more self-sufficient and less dependent on the import of goods. One of the ways the research project is tackling the great challenge of a project in this size, is its holistic experimental and creative way of approaching the design task. One such way has been to have design competitions, where landscape architects from many different places of the world were given the task of working with the project (UAC, 2011).



Figure 4. Dar Bouazza in 2005 and 2012 (Google earth). Fatoumas farm in the circle. The satellite pictures show the rapid spread of settlements in the area (white buildings).

4.4 FATOUMAS FARM AND THE FARMERS COOPERATIVE

Since the start-up of the UAC project in 2006, Fatoumas farm has been one of the four pilot projects. The aim of the pilot project 4, which is entitled “Pilot Project 4: Urban Agriculture + Healthy Food Production” The aim is to develop a modern organic food production (UAC, 2011) The farm is located in the peri urban part of Casablanca, about 20 km to the west of central Casablanca. The area of Fatoumas farm is 8000m². In addition to the research farm twelve other farmers in the region that have agreed on the concept of agro ecological production, are also using the food basket system. The farmers are all located within approximately 2km from Fatoumas farm and cultivate an area of 6 ha totally. The farmers also produce enough for their own sustenance (Giseke, 2014)

PP4 focuses on the four overriding research topics:

- Adapting to the consequences of climate variability and change, and thus promoting climate protection and energy efficiency
- Combating poverty (struggle for food-sovereignty and healthy food)
- Innovative strategy for sustainable land conservation
- Integration of Urban Agriculture as an element in urban development

4.5 THE FOOD BASKET SYSTEM

The food basket system is the main distribution line for the agroecological farmers to sell their produce. The costumers pay 3 months in advance for getting one basket per week with 15-20 kg of the season’s vegetables and fruits, all organically grown on the agroecological farms (Giseke, 2014). The farmers like this system for many reasons. One is that they don’t have to compete with the prices of non-organically grown vegetables on the local markets. With the basket system the farmers can charge a higher price for their organic produce, because the customer is aware of where it is produced. Another reason why the farmer likes the basket system is because they can sell different sized and shaped vegetables, that would otherwise be difficult to sell on a market. This makes the loss of vegetables kept at a minimum. The main customer for the basket is big families. Every farmer who is connected to the farm, and grows organically is connected to the basket system. The basket system is mainly marketed by its costumers spreading the information to others. Many of the costumers come from the city, are highly educated and had no previous connection with farming. They often bring their children for them to see and experience the farms activities. Rich educated people come and see the value of farming and their children can get a connection with nature.

The food basket system –in numbers (Giseke, 2014)

- On 1 ha a farmer can produce 10 – 15 organic baskets of 15 - 20kg weekly
- One basket can feed a 4-6 person family
- With 1 ha, one farmer can feed 10 families or 50 persons

- Feeding 2% (100 000 inhabitants) of Casablanca's population with regional healthy food would then require 2000 farmers using 2000 ha of farmland
- The Greater region of Casablanca is 120 000 ha (see figure 3)

4.6 FIELD OBSERVATIONS AT FATOUMAS FARM

Two hours of driving from central Casablanca to its western peri urban parts close to the Atlantic coast, is Dar Bouazza, a region traditionally known for vegetable agriculture. Dar Bouazza is not connected to the central parts of Casablanca by any direct bus lines or train. Shared taxis, or shared cars seems to be the most common way of traveling the distance. Busses cover some of the distances. Today the presence of the city is becoming much more apparent as new houses and apartment blocks are being built in the surrounding. Still most of the land is used for agriculture.

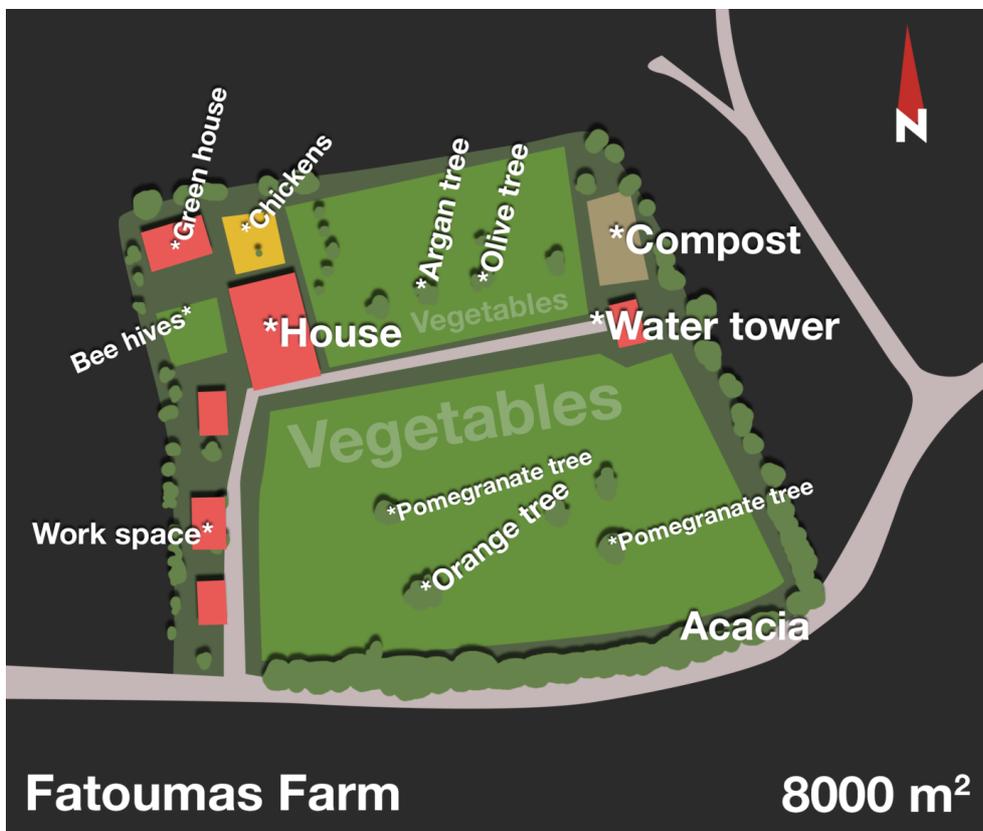


Figure 5. (Georg Krüger, 2015)

Fatoumas farm is 8000m². Most of the space is used for farming but there are also some facilities and a rather large house that holds both living rooms and spaces for educational purposes as well as a kitchen. Bee hives are placed on the farm, for honey production and pollination services. There is a green house for cultivating plants and educational purposes. The roof of a storage room has a 10cm thick soil layer with wild flowers and shrubs. The purpose of the green roof to contribute to biodiversity and for nectar for the honeybees on the site. The soil layer is also working as a temperature buffer during the warmer summer months where it will absorb some of the heat during the day and release it during the night. The farm is surrounded by a natural fence of the acacia tree and a few other trees and shrubs. This natural fence serves a number of different purposes. Because of the long thorns from the Acacia tree, it works as a natural protection against unwelcome visitors.

5. RESULTS OF FIELD STUDY (INTERVIEWS)

5.1 FATOUMA BENEDICH AND ALLAL

Fatouma Benedich is the owner of the agroecological farm in Dar Bouazza. The farm was started by Fatouma back in 2005 and immediately turned into the practice of agroecology. It is now part of the UAC research program. One of the most important goals of the farm is to educate the local farmers in the practices of agroecology, and techniques such as making compost. Other than being a pedagogic farm for the agroecological farming techniques there is also different social and ecological projects going on. When Fatouma bought the farm there was mostly farmland in Dar Bouazza. Today the expansion of Casablanca is present in Dar Bouazza as new residential buildings are being built in the surrounding areas. A trend that Fatouma is critical to because it is being built on good agricultural soil.

The farm is collaborating with the non profit organization "Terre & humanism", founded by Pierre Rabbi who is a teacher of agroecology. Some of the main methods and techniques used on the farm involve composting, crop rotation, intercropping, drip irrigation etc. On Fatoumas farm and on the agroecological farms, all vegetables, fruits and other products such as honey are organically grown without the use of chemical fertilizers or pesticides. Since the startup of the farm the concept of agroecological farming has spread to surrounding farms in the area through courses held at the location of Fatoumas farm. Because of the farms close connection with the NGO terre humanism, it has established a link to some horticultural and agricultural educational centers in France, where students from France visit the farm as a part of their education. According to Fatouma the farm is also open for volunteers who want to learn about agroecology and organic growing. For a small fee people can come and work and stay on the farm. The concept of the farm is open for a multitude of activities, and Fatouma is open for new ideas that could be implemented at the farm.

The vegetables grown are usually around thirty different species. Carrots, onions, tomatoes, cabbage, strawberries. Intercropping with different species of vegetables (and trees) is experimented with for reasons of pest control, weed minimization. One example is leek (*Allium ampeloprasum*) that is grown together with other vegetables to evaluate to see its effect as a pest reflector. The seed material used on the farm is derived from local breeds, so that seeds may be collected and used for next season. No hybrids are used.

Some trees have been introduced on the farm. The trees are argan, orange, pomegranate, olives and clementine. The introduction of trees is for experiments with intercropping trees and vegetables that can handle shade. The trees can also be pruned and give organic material for the compost such as leaves and branches. The acacia trees that surround the farm are nitrogen-fixing witch adds nitrogen to the soil. They are later pruned and the cuttings are used for making compost. All of the planting area is being systematically feed compost, and mulch produced on the site of the farm. The main purpose of the added organic material is to increase the micro flora and fauna in the soil, and to increase its water holding capacity and nutritional value. Working to build a healthy soil is one of the most important things that Pierre Rabi instructed Fatouma. Big improvements in the soils water holding capacity is now recognized compared to when the farm was established in 2006. The farm is self-sufficient with fertilizers and compost as it is made on the site of the farm. The composting project was initiated by Pierre Rabi when the farm was just established, and is now a standard practice at

the farm. Branches and vegetables residues are used for making the compost beds on the farm, that can be used for soil improvement after about 6 months. Nettles are grown for food, and as a compost activator, where it is harvested and mixed with the compost. Nettles is activating the composting process faster than if not used according to experiments done. Through the close collaboration with the NGO Terre humanisme, tools such as the wood chipper were introduced for making wood chips.

A lot of experiments are carried out at the farm, all within the framework of agroecology. The water from the house is filtrated in a gravel and sand filter before it is released into the ground. Water for irrigation is primarily coming from a deep well, which taps, into the groundwater reserves (coming from underwater streams from the Atlas mountains). Some water is collected in an underground container from the roof of the main building. This water is also used for irrigation. Rainwater from the roof of the main building is collected in a tank under the house. Because the no use of chemical fertilizers and pesticides, the infiltration from rainwater will have no risk of contaminating the groundwater or polluting aquifers. Drip irrigation is used for the majority of the watering of plants, and because of this, the total use of water is kept at a minimum. Another way of preserving both water and nutrients in the soil has been the work of enriching it with organic material, produced at the farm.

There are also some experiments with composting toilet going on the farm where human excrement is mixed with plant material and wood chips for decomposition. The purpose if for taking care of the nutrients in the excrement that is otherwise lost to the sea. The issue with human excrement is a problem in Morocco by today; often it is flushed straight out in the ocean or rivers polluting them. Solar cooking with the use of the sun as the only source of energy is another experiment that is being tested on the farm. A lot of firewood is used for heating when cooking every year in Morocco. The use of solar ovens during the warmer months could reduce the need for firewood and also strengthen the economy for many families, as the energy harvested from the sun is literally free.

Fatoumas vision is bigger than only the food aspect of farming. She is educated in the social sciences and was one of the leading figures of the women's rights movement in morocco when she was younger. And still the woman's rights issues have a strong focus on the farm. Fatouma points out that she is very passionate about the farm and the concept. She has a strong vision. The purpose of the farm has always been to serve as common ground for a multitude of different functions and collaborations. Fatouma says they are collaborating with different organizations that share the common ethical ground of women's rights, equality and support of the local community and of course sustainable farming. Because of all the activity on the farm, it draws the attention from both locals and visitors from Casablanca as well as foreigners who are interested in sustainable farming.

The growth of the city out on the farmlands is a worrying situation and the farm is functioning as a model for preserving the farmlands. If she can come up with a system that makes it profitable for the farmers, maybe they will remain farming instead of selling their land to the building companies. There is also the problem that young people today associate farming with the lower class. Many young people move to the city to get a better life and dream of material things such as cars. It is a challenge to make farming attractive for the younger generations, and not make them associate it with hard labour and low income.

Fatouma see high potential for UA in Casablanca. It is clear that people of all ages enjoy the kind of atmosphere found at the farm. When people come here they smile, and the people working here are happy, says Fatouma. From this we can learn how to create living and

vibrant places for the city where food production and social meeting places can co exist and create synergetic effects.

5.2 ABDALLATIF, AGROECOLOGICAL FARMER IN DARBOUAZZA

Abdallatif has a 2 ha farm, where he lives with his family and works. One ha is used for fruit and vegetable farming; the other one is used for grazing animals, Cows and donkeys. Abdallatif has been farming seven years with the agro ecological methods he learned by the program at Fatoumas farm. Now he uses no chemical pesticides or fertilizers. He is also connected to the food basket system. The costumers can come and visit the farm and see how the vegetables are grown for themselves.

Abdallatif says he now have to work more than when he practiced monoculture agriculture with chemicals. Now there is always something to do on the farm, but he likes it better because now the work is interesting. Now he feels that he have more control over his own situation, which he likes. He grows around twenty different vegetables on the farm. Sometimes he tries new varieties that are not producing well. He can now afford to have some crops that fail, because there will be other crops that are more successful. The quality of the vegetables is better now he says. He also feel better now when not being exposed to the chemicals, before he had problems with his respiration and he didn't develop his skills as a farmer anymore since the work with a single crop was more monotone and predictable.

The techniques that he uses now are drip irrigation, mulching, composting, intercropping, tunnels (for strawberry's during the winter months etc). His latest experiment that he proudly tells about is agroforrestry where he is trying to grow vegetables among fruit trees such as olives, clementine, pome granate etc (see photo documentation). The vegetables for this design are chosen for having requirements of part shade.

He experiences that he have more money now then before because he doesn't have to pay for chemicals, seeds or fertilizers anymore. He points out that having low cost has been an important factor for improving the family's economy. The only thing he uses now is the water and his own work, and the water is free because it comes from e deep well on his property. He now have more control over his own economy, and because of the many different crops he grows he have more security, because if the need for some vegetable is low, there are always other crops on his farm that he can trade and sell instead. Another positive aspect of growing a wide variety of vegetables is that the family is almost self-sustained with fresh vegetables and fruit from their own farm. This wasn't possible when he was growing a single crop. Apart from the vegetables that he grows and sell, he also have some animals like cows, rabbits, chickens and a guard dog. The manure from the animals is used as fertilizer for the vegetables.

5.3 UAC RESEARCH TEAM, JULIENE BRANDT (GER) FOUAD AMROUI (MOR)

The problem today in Casablanca and many other mega regions and large cities in developing countries is that these cities grow uncontrolled with informal settlements. Many times and in the case of Casablanca, the planners didn't have a goal or underlying strategy for the planning. There is also a gap between the plans for the agriculture around the city and the expansion of physical city borders. There is no real communication between these departments. In this situation of land use, agriculture is the less competitive land form.

Associated with this problem is that there is a lot of land speculation going on in Casablanca. There are many private interests in the future plans for the city, some having more money and influence than other interests. We have to show for the politicians that the whole city, not only the poor, will profit from UA and the green infrastructure it could create. With the UAC project we want to address the importance of creating a green infrastructure that can handle a multitude of needs and purposes for the growing city. The strongest argument for UA is its multifunctional role and we already see the positive synergies created from it in our pilot projects. With the focus on local food production but still being broad enough to engage issues like water treatment, soil, climate, poverty and social networks. An added value from UA in Casablanca could be to make the city more attractive for tourists, which could contribute to the city's economy.

The project has already been successful with cleaning the water from a local bathhouse (Hammam) in Ouled Ahmed, by a constructed wetland next to it, with local plant material. The wetland also functions as a recreational park and adds biodiversity to the neighbourhood. This example shows clearly the multifunctional approach we are designing for in this project. We need this kind of good results to show for the politicians to be able to go to the next step in implementing this strategy for Casablanca.

5.4 PHOTO DOCUMENTATION: FATOUMAS FARM



Figure 6-8. Top left: The making of woodchips from acacia tree. Top right: Drip irrigation is used on the farm. Bottom: Intercropping of vegetables and fruit trees (olive, argan and pomegranate).



Figure 9-13. Top left: Allal the gardener, the Author and Fatouma –the owner of the farm posing next to the solar oven. Top right: The compost after less than six months Bottom left: The application of compost to the vegetable garden. The compost is put in a ditch to add organic material to the top soil. Bottom right: The house and facilities on the farm with cabbage in the foreground.

5.5 ABDALLATIFS FARM



Figure 14-15. Left: Allal and Abdallatif at Abdallafits 2 hectare farm. This picture is showing on of the latest experiments with fruit trees and vegetables grown together. Right: Abdallatif and Allal in Abdallatif's tunnel. Tomato seedlings in the background.

6. REFERENCE SITE. THE FOOD FOREST IN INRAREN AND PARADISE VALLEY

FIELD OBSERVATIONS AND PHOTO DOCUMENTATION

Up in the mountains, two hours of drive from the nearest village lies the small town of Inraren and paradise valley. Both are located along the mountain river in a canyon in the Atlas Mountains. The food forest in Inraren and Paradise valley are estimated to have been cultivated in the same manner of food production for over 2000 years. The plantations are designed by terracing to receive the water from the river through canal systems that flow through them. The food forest is divided in seven segments that each receives water one day a week. There are variations in the water flow through out the year, and the flow is regulated so that each part of the plantation gets its share of water. The food system have no external inputs of fertilizers, all is coming from the mountain water, river sediment and circulation of nutrients within the system. Some nitrogen fixing trees from the fabace (bean) family were also identified within the system, possibly for nitrogen fertilization. The main concept of the food system is based on perennial food crops dominated by fruit trees at different heights (understory, middle story and over story). The food forest has been producing the same food crops the whole time, consisting mainly of: Date, banana, pomegranate, orange, olive, orange, clementine, pepper and beans. By the constructed terraces, and from the roots from the trees, the soil degradation due to erosion is kept at a minimal. No chemical fertilizers or pesticides are being used. All of the fertilizers are coming from nutrient cycling within the system itself and from the water from the river. Goat and sheep manure is spread in the plantations, especially under banana trees. All the plant material is coming from the plantation, taken as seeds or vegetative saplings. It is clear that this growing system is robust and resilient, due to its low tech standard. If it is a bad season for one crop there is big chance that there are other crops that will have a better production, and minimize the total loss. The watering system being build by stone and cement canals are easily repaired if they would break. The simplicity of this system is its beauty. When wandering through the food forest and looking at functions that could be translated to an urban context, one thing struck me was its aesthetically beauty. The wide range of plant species sharing the same space in a landscape of stone terraces and the canals makes this place truly inspiring.



Figure 16. The town of Inraren on top and the food forest under(green). (Google maps 2014)

6.1 PHOTODOCUMENTATION: INRAREN AND PARADISE VALLEY



Figure 17-19. Top left: Intercropping with Banana and peppers in Inraren. Picture top right: Cool farmer by his plantation and the main irrigation channel, Inraren. Bottom: Food forest system with date palm (in the back) and banana trees (in the front) with fellow student Axel Wendt from SLU, alnarp.



Figure 20-25. Top left: cheep manure as fertilizer under banana tree, Inraren. Top right: Farmer showing the irrigation system. Inraren. Middle left: Irrigation channel in Paradise valley. Middle right: The author by an example of terraces (olive), paradise valley. Bottom left: Ditches and swales for irrigating Banana trees, Inraren. Bottom right: Paradise valley and its over story date palms seen from above.

8. DISCUSSION

The rapid urbanization worldwide is complex and brings a wide range of problems to the table, which needs to be solved. There is no simple solution to it. And the solution isn't going to come from one field of research, but a wide range and be multidisciplinary in its nature. The approach of solving some of the problems by UA and green infrastructure seems truly promising due to its multifunctional nature. By maximizing landscape contributions and designing landscapes so that they can integrate many different ecosystem services (Lovell, 2009). In the case of the UAC project in Casablanca it is still in its evaluation face. However some conclusions can already be drawn: The pilot project at Fatoumas farm was showing positive results in many of the fields ecological sustainability, social and economical sustainability. It contributed to a more varied and healthy diet for the farmers involved in the project and their relatives. (Giseke, 2014). It also led to an increase in the number of small farms in that area. The food basket system expanded its distribution channels and was branded as regionally specific products and sold to hotels and other important institutions (Giseke, 2015).

The pilot project showed that it was proven clear that the farm served as a centre for knowledge and as a bridge between academia and the local population, and even as a bridge between foreign knowledge and local by its close connection with the Terre & humanism foundation. The results of this study showed that the farming techniques practiced at the farm is widely appreciated among the farmers connected to it. One of the biggest achievements of the farm in Dar Bouazza is serving as a research station for sustainable agriculture. The experiments at the farm are plenty, both in growing techniques and sustainable energy technology. Some farming techniques that is thought at the farm may be more labour intensive, then simply growing monoculture. As most of the farms are relatively small (2 Ha or less) and practice policulture there are some obvious problems with fully mechanizing it. However, for the farmers who have been interviewed for this thesis, they all share the same view that the work is more interesting and rewarding. This points to the conclusion that people put a high value in doing meaningful work that is developing their skills and mind. The pilot project resulted in nutrition and environmental education curricula for the development of school gardens (Giseke, 2014).

There are a few other functions that possibly could be integrated on the farm and on its surroundings that could increase the positive synergies without decreasing the quality of the current ones. A community building with shared equipment could strengthen the economy of the farmers, as they would share some expenses. 8000m² seems to be just the size that can be managed by a family.

The food forest in Inraren showed to be an interesting case of a sustainable food system with many good designs that could be implemented in an urban context. Primarily the design focused on using perennial food crops intercropping together in different heights for using the sun optimally and giving shade to more shade tolerant species is one example that could work out for an urban food forest. If sewage water or storm water from the city could be cleaned, it could be used for watering a food forest similar to the one in Inraren. The design of this food forest could also work for other purposes such as recreational, and cleaning the urban air from pollution (and could also clean the water to some extent). The open canal system in Inraren adds both to the aesthetics of the place and is used for irrigating the plants. Research could be done in this field to see if there are possibilities of having canals collecting storm water or possibly even grey water from households in canals that could be used for irrigating food crops.

The design of the food system in Inraren, was low tech but still provided plenty of food. It shows that a good design based on simple techniques can be very productive. A similar approach can be used for a green infrastructure for the city whether it is for food production storm water detention or recreational purposes.

8.1 METHOD DISCUSSION

There have been some obstacles writing this thesis, which delayed it. When I came to the location for the field study, I realised that the context was different from what I was expecting based on my research on the case. There has been a difficulty to get a good balance between a general take on UA and the specific case for this thesis. Another major issue for this thesis was that I didn't get as much information from the UAC research team in Casablanca that I needed. Thus some of their conclusions have been missed out in this thesis. One reason for this was probably due to the fact that French language were primarily used during their meeting with their Moroccan counterparts. This thesis was based on both literature and interviews. As for the interviews there was an obvious risk of misunderstanding due to cultural indifferences. Sometimes I experienced that the translation didn't correspond with the intended question, this was another reason for having a more informal and "open" interview. Awareness of cultural indifferences was taken into consideration, but wasn't seen as a problem during the interviews.

8.2 FURTHER RESEARCH

The subject of UA for a growing urban population is highly relevant today and more research on the subject is needed. Conclusions can be drawn from similar projects in other cities around the world. It is important to understand that the development and growth of the city depends on many different factors, and has many different interest groups that haven't been included in this thesis (financial, industrial etc). Shortly mentioned in this thesis however is the situation in Casablanca where land speculation is a problem for the planning of green infrastructure an UA in the city. If the pilot projects in the UAC project will prove their points they will become important material for political regulations in favour of UA and green infrastructure. Without these physical pilot projects it would be more difficult to introduce this concept politically. This thesis didn't cover the actual amount of food that was produced at the farm with agroecological methods in relation to more conventional methods and monoculture. This is of course important to look into for a more comprehensive comparison between different growing techniques.

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