INTRODUCING URBAN AGRICULTURE RELATED CONCEPTS IN THE BUILT ENVIRONMENT: THE PARK OF THE 21ST CENTURY

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Keywords: decentralisation, red/green mixture, city agriculture, integrated design, interconnection streams

Summary

There is a rising need to interconnect different 'essential' streams inside cities at scales closer to users. Integration strategies for wastewater management and sanitation, even possibly together with energy-generation, comprise direct linking with neighboring subjects like agriculture (especially urban farming), aquaculture, horticulture and food security, health care, urban planning, as well as waste management in general and the organisation, maintenance and assurance of indispensable parts of closed cycles. Ecological sanitation within these integrated projects will have to be based on a closed-cycle flow of nutrients and preferably energy too: the basis of future healthy cities. Permaculture forms an excellent basis, for it is based on observation of natural systems, combined with the experience of traditional farming methods and modern science and technology, to create a cultivated ecology in which people more actively can get involved. Besides of this, existing green places and parks in and around urbanised areas are pressurized by changed use or even miss-use, governance based on lowering maintenance costs, and urban extensions (and 'in'tensions). There is a rising call for additive functions to preserve these green places against (claimed) more economical developments. Within the process of enduring worldwide urbanisation, in the 21st century the introduction of agriculture, horticulture and aquacultures may help to interconnect necessary green places with social activities (gardening, food cultivation, recreation), more sustainable solutions concerning neighbouring streams (waste(water), energy-generation, food production) and combined urban 'red/green' development. This will be the guideline for the 'Park of the 21st century'.

1. Introduction

The presented research tries to demonstrate the need to include interdisciplinary approaches to the integration of strategies for raising public awareness, marketing of the different qualities of water (cascading) and energy (exergy), and establishing a service business for building and operating more decentralised installations. Integration strategies for wastewater management and sanitation, even possibly together with energy-generation, comprise direct linking with neighboring subjects like agriculture -especially urban farming-, aquaculture, horticulture, health care and food security. The background of this research is the recognition of a need to compare alternative sustainable concepts, techniques and belonging structures on more aspects than the ones being indicated by the existing paradigms and dominant actors in urban planning. The basis forms an urban planning that is based on 'interconnection', as well as waste management in general and the organisation, maintenance and assurance of indispensable parts of closed cycles. The methodology of the research is based on the 'regulative cycle' of Van Strien, in which a distinction is made between theoretic parts on the one hand and practice-related parts on the other hand. The theoretical part concerns flow-analysis of existing- and new sustainable technologies for the preservation of the (energy, water and waste) streams, the analysis of the different options of transportation and the belonging technical infrastructure and analysis of possible (different) levels or scales. The practice-related part of the research consists of case studies (existing-, recently built- and planned projects) concerning (common) solutions (at different scales) solving problem of turning these main streams into cycles. Besides of these case studies concerning parts of the main research hypothesis, in one 'integration case' the outcome will be tested in a concept and belonging device.

The idea is to make urban development, mostly resulting in buildings and (technical) infrastructures, following to the (social) needs and goals, which form the basis of physical networks of the logistical chains, and not the other way around, like it can often be qualified today. In this way it will be possible to uncouple sustainable solutions from the existing 'centralisation-paradigm', without the release of other relevant criteria for today's society.

The research has been commissioned by the TU Delft (Delft University of Technology) as part of the DOSIS (Sustainable Development of City and InfraStructures) project to investigate and develop decentralised sanitation, energy and reuse technologies. The aim is to research the spatial, social and enviromnent related technological consequences that the implementation of these technologies might have, and to define the conditions within society, with emphasis on urban planning and network architecture principles.

2. Interconnecting energy and waste(water) related systems and infrastructures

2.1 Towards a circular approach of resources and wastes

It is important to realise that environmental-effects not only have to be negative. There can be positive aspects too, which can possibly compensate to some extent negative effects. Well known is the 'Eco-device model', with incoming and outgoing streams and respectively linked to primary harmful aspects for the environment (in- and outgoing streams), and secondary harmful aspects (coupled to the investigated system or area). The disadvantage of the schemes like the 'Eco-device model' is its constrain to the stochastic behaviour of input and output. It is important to see the eco-device in a larger framework, as a part of what is called the 'environment-circuit'. In this 'E-circuit' the chain in/out is specified to the three main units: extraction, production and consumption, which through so-called leakage-flows have a continuous relation with the ecological basis (Figure 1).

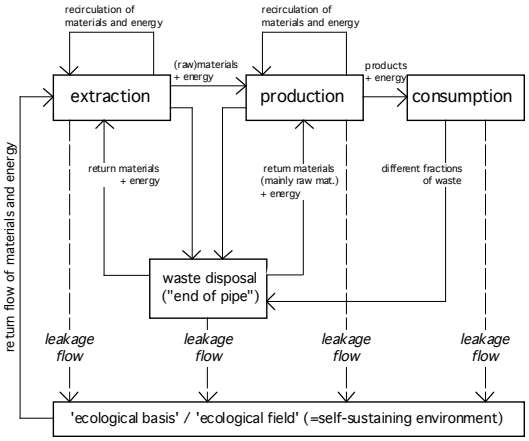

Figure 1 the Environmental Circuit (source: Kop)

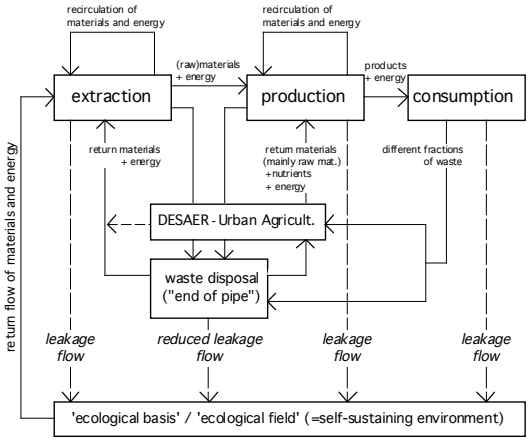

Figure 2 DESAER systems within this E-circuit

An important link in the desired transformation of our society from one based on linear attitudes of resources and wastes, towards a circular one, is a changed way of handling sustainable energy and (ecological) sanitation. Ecological sanitation is not merely about a new latrine design. It comes down to thinking more in nutrients and raw materials than in wastes, which 'are to be disposed'. Within the figure of the Environmental circuit Decentralised Sanitation and Energy Reuse (DESAER) can be placed in between the (end-of-pipe) waste disposal and the three main units (Figure 2). It is a 'closed-loop-approach', in which excreta are returned to the soil instead of water. It comes down to a (better) formalisation of the existing 'leakage flows' between the cultural world and the natural world, or 'ecological field' as a self-sustaining environment. In this way the closed-loop approach is non-polluting, keeping fresh and marine water bodies free of pathogens and (too many) nutrients, while the environmental and human health risks are minimised or eliminated.

There is a need for some relativization: unfortunately, half of humanity still does not have access to any type of sanitation. On the one hand this is a threat to the ecological field. On the other hand it still might be the basis for a critical look upon existing 'conventional' approaches, which have been realised so far, and (mostly) are to be realised in these parts of the world too. The dilemma is: fast-arrangement of sanitation systems for the people who do not have access to sanitation (being a human right) and additional global environmental consequences, or ecological sanitation: on site systems with, especially in the beginning, a slower rate of implementation and therefore -in the beginning- not following the equity principle within Sustainable Development. That is, from the point of view of existing paradigms and a literally approach to this equity principle. Apart from that, ecological sanitation is valuable for a number of other reasons, varying from better food production to secondary benefits, like improvement of soil structure and water holding capacity. The two main design features of ecological sanitation are urine-diversion and composting techniques. The first can be interconnected to nutrient recycling, the latter to nutrient and energy recycling. In both cases it is possible to manage urine, faeces or excreta with little or no water. But to ensure an ecologically secure way of managing excreta it is important to combine these systems to energy production, for instance biogas production, and/or integrated food production. Within these integrated projects concepts will have to be based on a closed-cycle flow of nutrients. Permaculture forms an excellent basis, for it is based on observation of natural systems, combined with the experience of traditional farming methods and modern science & technology, to create a cultivated ecology in which people more actively can get involved.

2.2 Important changes in urbanised areas

2.2.1 seize of space

In case of interconnection of wastewater-, energy- and solid waste related concepts especially its relation to the (overhead) technical infrastructure and the possibilities to bend these critical streams, for urban development and sustainable life, into sustainable cycles within autarky-approximating concepts is of rising importance. Scale-elements, like the covering of distances and seize of (ground related) space are getting more important every day. Apart from the lack of space in most urbanised areas this is also the result of the continuously inclining environmental load of the existing, in developed countries, growing aging of technical infrastructure and the lack of space for replacing infrastructures due to off-written existing technical infrastructure that stays in the grounds as a residue and all kind of new (mostly communication) wiring.

When agricultural-, or non-cultivated land is being transformed into for building sites, its price per square meter raises significanty. The breakthrough of the almost unfathomable deliberation of values concerning this raise, or the bringing up of alternatives which explain the illogically aspects of it, might lead to manageable tools. Apart from this, the development of building sites can be characterised as an almost autonomous process, in which all parties out of their own background and paradigms make the highest demands. But there is no, or little matter of mutual tuning in or the putting up for debate of individual starting-points. Architects and installation advisors hardly are interested in the infrastructure at city district level. Even totally unnecessarily infrastructure is being accepted as naturally. The (civil) engineer on its turn in general doesn't care for the real needs of infrastructure. The side effects are unnecessary high prices for building sites (before ‘building’ actually starts) and almost impossible, or unaffordable flexibility for change towards sustainable alternatives. Most of the times interesting alternatives are made impossible due to the realised infrastructure and/or typology. The infrastructure then only facilitates (less sustainable) forms of energy-, water- and waste related technologies. Moreover, some of the technical infrastructure even is superfluous.

Besides, there is no question of a possible fair comparison, for the alternatives almost never are optimised to the urban- and technology related aspects on the larger scale(s) of implementation. Most of the times the – supposed- less important- environment-related aspects consequently are contracted out. In some areas in the Netherlands, but also in other developed or developing countries with larger areas and more non-urbanised space, the scale-question concerning sustainable concepts, belonging technical infrastructure and its use of ground plays a part. Apart from that the changing of certain qualities of the prepared sites (e.g. strongly reduced (technical) infrastructure and simpler and less sizeable forms of execution, management and maintenance) are no subject of discussion and scarcely brought in practice. The consequence is that governors don't (have the courage to) differ from the common path of practice and existing paradigms. Better tuning of infrastructure and use may lead to a greater differentiation of prices of sites and consequently to better opportunities for sustainable concepts. Although one should put forward that site prices depend on more aspects than the former stated only, a re-valuation nevertheless seems to be necessary.

In conventional projects a consequence of the need to transport energy, water and waste to centralised plants outside cities and consequently large technical infrastructure networks, is belonging use of energy, water and materials. These technical infrastructures have a non-negligible environmental impact and are relative expensive features in urban planning. Apart from that uncontrolled leakages, inclining rotational speeds, changing technologies and especially aging of existing technical infrastructure -in Europe in particular- will lead to huge problems and costs within the next decades. More actual is the rising call for flexibility of (parts of) buildings and recently even entire districts or urbanisations. Precisely these 'flexibility-need’ can be connected to (a) clear optimum of scale(s). The conventional, more centralised solutions nowadays still translate this need for flexibility into the creation of overcapacity of (technical) infrastructures, treatment- and generation systems. One could state that the infrastructure of the essential (or critical) streams, due to its ‘path-dependent’, long term character and the existence of a limited number of dominant actors per network or stream, is determinative to what degree a project -varying in scale from a (part of a) building to a city- will or can be sustainable. In case of the energy streams for instance, conventional sources of energy are being extracted, isolated and in high concentrations brought together in central installations in which they are converted into large amounts of energy which via large distribution networks can supply large areas with energy. The loss during conversion and distribution is overshadowed by the abundance of energy that can be generated inside these over dimensioned power plants. Most of the sustainable energy sources however are present everywhere but in relative small concentrations and most of the times less continuous available. For most of these sources it is illogical and not profitable to generate high-energy revenues and distribute it to larger areas. Especially the (waste)water infrastructure and the energy infrastructure can be characterised by transported streams which are not drawn up out of ongoing ‘ecologisation’ and dematerialisation but out of efficiency in central management and other economical factors. From the point of view of sustainability the technical infrastructure therefore seems to be insufficiently efficient.

Science, and more often the market too, brings up a rising number of solutions that imply possible smaller scales of implementation. The consideration is a possible reduction of infrastructure and better visibility and tuning in to the demand and therefore more flexibility.

This paper focuses on the interconnection of sanitation (organic waste- & wastewater management) with food production and energy generation. Especially in the field of small scale-, ecological sanitation systems important efforts have been made. The idea behind these kind of smaller systems, often based on natural technologies, is their relative simplicity and adaptability, and therefore their possibility to create extra (real sustainable) capacities in situations where:

(1) the centralised systems have not been built yet,

(2) the existing systems (or surrounding environment) have reached the limits of their capacity and new buildings, districts and/or higher densities are planned (possible use as a temporary back-up),

(3) the bio-climatical, geological or circumstancial characteristics make interventions in the subsoil difficult and/or expensive, and

(4) in case of desired improved environmental performances e.g. through interconnections with other 'infra' systems.

These kind of small scale alternative systems most of the times still are more expensive, due to their limitation to pilot projects, and the little 'economies of scale' in the production of components. The main cost factors are the construction and maintenance of the belonging 'small-scale networks'. This goes especially for sewage networks. Of course there are also other disadvantages. Sanitation for example is to a large extent a social phenomenon, rather than a technical. Therefore it is essential that background information on cultural, social-, economic- and environmental factors influencing sanitation behaviour is acquired before actual planning can start. This is especially true when a new technology is to be introduced. In case of systems based on natural technologies one does have to take into account that these are vulnerable in case of inaccurate use or sabotage. Also they depend more on natural light and among other things this means that these renewable sources have a relative low energy density and subsequently large use of ground. Considering the use of ground of renewable, energy related technologies and the daylight dependence of the water treatment solutions which are based on natural technologies, this leads together with the ever decreasing available space to the conclusion that the optimalisation of the use of natural light and use of ground and daylight-related space(s) of surface dependant technologies should be investigated more closely. Through the so-called multiple use of ground one can prevent the rejection of these small-scale sustainable alternatives on account of unsustainably high costs, due to the relative large amount of needed ground surface. It might become the basis of new forms of Permaculture, because in most of the realised projects that are based on the principles of Permaculture until now, this aspect of use of ground still is underexposed.

2.2.2 pressure on green spaces

In and around urbanised areas existing green places and parks are pressurized by changed use or even miss-use, governance based on lowering maintenance costs, and urban extensions (and 'in'-tensions). There is a rising call for a more offensive approach, using additive functions to preserve these green places against (claimed) more economical developments. Ecological city farms and decentralised energy production- and water purification-systems, with high aesthetic qualities, which are integrated in these green areas, can help to retain the green character. Moreover it might function as an instrument to preserve the original ecological- or agricultural structure of the 'genius loci' of the site. In that way it helps to revalue existing cities, making them more liveable, by adding new functions that facilitate residents to involve, and therefore improves consciousness and commitment. Liveability, together with consciousness and commitment, is a precondition for sustainability. Conversely it is not.

Through introduction of concepts like integrated decentralised water purification systems the aesthetic quality of the surroundings can be improved too. The presence of water and natural systems in buildings, neighbourhoods and cities offers starting-points for landscape- or urban design. This goes especially for separated strips of small, enclosed green areas, which now often have little or no spatial-, environmental- or social function. Within the process of enduring worldwide urbanization, in the 21st century the introduction of agriculture, horticulture and aquacultures may help to interconnect these (necessary) green places with social activities (gardening, food cultivation, recreation), more sustainable solutions concerning neighbouring streams (wastewater, energy-generation, food production) and combined urban 'red/green' development.

2.3 Case study EVA Lanxmeer, Culemborg (The Netherlands)

2.3.1 the Lanxmeer ecological city-district

The project EVA-Lanxmeer concerns an ecological settlement within the small-scale city of Culemborg, surrounded by an attractive river landscape. The location of the EVA project is unique: near the central railway station of Culemborg, on 24 hectares of agricultural land and some orchards. It is the first case in the Netherlands in which permission was given to build near to-, and partially in the protection zone of a drinking water extraction area. The regional government allowed building at this site only if guarantees were made that it was built carefully according to modern 'deep green' principles. The EVA Lanxmeer project started in 1994 with the founding of the 'Stichting EVA'. In the following years, plans were developed in full-cooperation with the municipality, province and the drinking water supply- and energy company. More innovative was the integral participation of future residents and other relevant parties, like environmentalists, architects, energy- & water specialists, landscaping architects, sociologists, right from the initiative. The project is being realised in phases. In 1999 the first phase, the construction of four clusters of 50 houses, shaped around half-open courtyards started. At this moment the first two phases have been finished, the third, fourth and final phase have started or are under development. The project EVA Lanxmeer offers conditions for living, working and recreation in a natural environment, within the city conglomeration. It consists of approx. 240 houses and apartments, ecological office buildings, a biological city farm for local food production, the EVA Centre (Education-, Information- & Conference centre for Integral Ecology, with Hotel), a Sustainable Implant (incl. Living Machine & Biogas generation plant, Retourette, E-Fulfilment), and (collective) permaculture gardens.

2.3.2 the 'Park of the 21st Century'

Local interventions, e.g. with regard to sustainability, can be made without leaving the existing scaling-up The overall design of the district Lanxmeer and the architecture of the most of the buildings is based on permaculture and organic design principles (Figure 3).

The structure of the urban plan is mainly based on the record of the existing landscape (www.evalanxmeer.nl). Especially the subterranean structure has been used for the overall plan, the water zoning- and ecological plan. Besides of that general principles of Permaculture affected the spatial structure of the plan, especially the green zoning.

Figure 3 part of the Lanxmeer district

Figure 4 impression of the district (phase II)

There is a gradual transition from private-, semi-private-, and public space towards a more natural landscape in the protected zone of the Water Company. Basis was the creation of four different green zones (actually five if one counts the private gardens, within the half open courtyards), which are connected spatially and ecologically: (1) the collective gardens, as a part of the different building clusters, with playgrounds, relax areas and so called 'edible gardens', (2) public green with retention ponds, extensive planting and reed beds, (3) agricultural grounds, city farm and orchards, and (4) ecological developing areas with infiltration ponds, woodland and 'dry-' & 'wet' hayfields. Together these green zones form an environment that displays the diversity and resilience of natural ecosystems. It can be called the 'Park of the 21st century'. Moreover because of the added links to the (waste)water-, energy- and waste concept of Lanxmeer. The arrangement and the management of the four zones is oriented on biodiversity, natural dynamism and a coherence between *elements, places* and *processes*. The natural cycles are paramount within the overall structure. The different zones are linked: (1) physically, through the design of watercourses, (informal) paths, green belts and the recycling of 'raw materials', nutrients, plants and products; (2) spatially, through the intensified experience of unity and 'soft-' and green delimitation between public and private areas; (3) ecological, through a larger diversity and vitality of the whole; and (4) socially, through the joint use and management, while (future) residents are even invited to participate in several realisation processes, among which the design, building, management and further development of their environment.

2.3.3 triad: Sustainable Implant, EVA Centre and ecological City Farm

The City Farm 'Caetshage' (near to an existing creek) and the EVA Centre (next to the railway station) form both the important ends (or beginnings) of the main east/west greenbelt that forms the backbone of Lanxmeer, with in the middle the former water tower, that is going to be re-developed too (Figure 4).

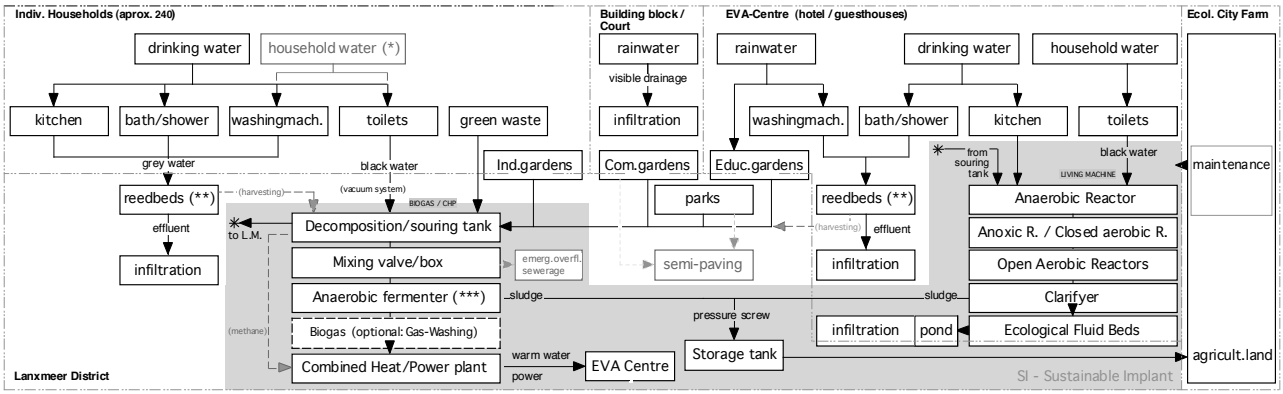

Figure 5 the treatment and cascading of the different water-related streams in the Lanxmeer district

The City Farm is situated in the originally agricultural area in front of the water extraction area. In buying houses the residents of Lanxmeer partly have contributed in the realisation costs. In return the residents can visit the farm freely, and if desired even can help with the maintenance of fields. The idea is that many people like to garden, but don't have sufficient time to maintain their own kitchen garden. Nevertheless, the City Farm is supposed to work independently. Plan is to include a small-scale 'care- function'. Apart from that, the City Farm offers recreational facilities for the residents of Lanxmeer and Culemborg, Another important role is set aside to the maintenance aspects and collection of green waste by the city farmer. Together with the remaining green waste of the other green areas of Lanxmeer, the kitchen- and green waste of the houses ('garden waste') and Lanxmeer's sewage effluent, this is being transported to the Biogas-plant within the concept of the Sustainable Implant, next to the EVA Centre(Figure 5). The role of this so-called Sustainable Implant (or: S.I.) is not only ecologically, but also introduced from a social-, participative and educational point of view. Separate water systems for drinking water and water for domestic use are installed in all houses (the latter though still isn't apt for use due to legislation changes), and also decentralised separate sewage systems for 'grey' and 'black water'. Grey water is filtered in wetlands in the centrally situated green 'backbone' of Lanxmeer and fed into the surface water. The Sustainable Implant cannot be regarded as a fixed design that can be repeated. The instrument comprises a guiding principle for a sustainable solution to the mainly non-sustainable streams in new or existing neighbourhoods. On a neighbourhood level the S.I. entails the design of a more sustainable main structure for the transportation of (waste)water, nutrients, energy, materials and waste. The Sustainable Implant in fact is a combination of several decentralised, mostly on natural technologies based concepts. The basis is formed by an exergy, or cascading approach: separating the qualities and quantities of the existing streams. Other components of the Sustainable Implant besides the Biogas plant are the 'Living Machine', the 'E-fulfilment miniload', a 'Retourette' and additive educational functions. The instrument constitutes the interconnection of the water, waste and energy streams, making direct use of the different qualities and different scales: the Culemborg region, the urban district Lanxmeer, the city-farm and the nearby EVA Center. In this way it becomes a hub for sustainable development in the Culemborg region, and through interconnection even for overhead scales.

3. Conclusion

It is important to change the general attitude towards the different components of design, development, use and management of urban areas. Instead of the different kinds of infrastructures, with belonging solutions, it would be better to introduce a 'spatial infrastructure' based on natural technologies: infrastructure being a design component of mixed ecological/spatial transformation processes. In this way, design component quality related aspects (ecological, spatial and social) can be linked to the (spatial) infrastructure and improve the visualisation of quantity related solutions. Eventually leading to better consciousness and sustainability. It might prevent for future ecological, spatial and eventually social problems due to aging-, and capacity exceeding consequences of the existing infrastructures. It is a way to prevent urban development and eventually the 'suprastructure' to go to rack and ruin, due to an infarct of this invisible, but critical part of urban life. A way to do so is the 'interconnection' of different themes and cycles within cities. An example is the linking of sanitation to energy- and food production. The appealing-, and already partly realised, example of the linking of agriculture, waste(water)treatment and energy production in the urban district Lanxmeer in Culemborg might be exemplary for the potentials of the supposed need for a change in attitude.

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