

When Systemic Sustainability is an Everyday Struggle: an Emergy-based Analysis of a Dog Shelter

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ABSTRACT

Although neglected in the narrative about smart and sustainable cities, the communities of animals should be regarded as part of the citizenry, for biophysical, systemic and ethical reasons. The structures taking care of the abandoned dogs in most cases can count almost only on private donations and voluntary work, despite the relevant resource flows needed for the system management. In this work, an emergy analysis is presented for a Dog Shelter, located in North-Eastern Italy, that hosts more than 100 abandoned dogs (plus as many cats), providing health care, food, shelter, company, and -in several cases- specific physical and psychological support. The Shelter provides also the formation of volunteers and, thanks to several public events, promotes public awareness and possibly the re-integration of the four-legged guests in a family. Emergy accounting results showed the criticality of a system that cannot define a budget in advance, nor make any reliable prediction about the flows of resources needed for the next year, or even month. Furthermore, it was pointed out the need for a continuous feedback action between the image of the structure, carried by its own activities and by the public events, and the flow of donations supporting the Shelter, that in turn contribute to increase the quality of the service. The sej/dog was calculated for the whole care of the “average dog” during one year.

INTRODUCTION

The concept of *smart city* has played in recent years a central role in several systemic planning of the urban areas sustainability. The features a smart city should exhibit are usually listed referring to some kind of smart mobility, smart government, smart environment and smart economy, in turn represented by effective local and global interconnectedness, green energy and buildings, integrated ICT & eGov, entrepreneurship and innovation, all focused towards the smart living of “culturally vibrant, happy and healthy people” (www.smartcity.org.hk). Unfortunately, this picture has very little to do not only with the reality of the cities worldwide, but also with the actual possibility to reach this objective along the way indicated by this narrative, first of all based on the digitalization, as far as the scenario remains anyway well dip in the business-as-usual conceptual framework. The task of analyzing the systemic and ethical flaws of this kind of smart cities is well beyond the scope of this contribution. Nevertheless, the factual complexity of a city and the interconnectedness of its problems may be represented by the neglected role of several citizenry subsystems, among which the animals play a peculiar role. In general, the living creatures that are tacitly included in the smart city narrative are only humans. Vegetation is regarded mostly as a well-being resource, confined in the definition of “green areas”. Animals are usually not considered whatsoever, despite their being actual, yet non-represented, members of the citizenry. This holds for bees, birds, bats, insects and of course for any kind of pets. As a matter of fact, dogs play an important role as a systemic resource, providing company and fondness to different categories among

the weakest in a community, such as children and aged people. Especially, the presence of a dog in a family often allows a better education of the children, who may learn about how to manage and participate in the social life, in so contributing to the formation of more responsible human citizens. In general, even without considering the (anyhow right) ethical instance of the dogs well-being *per se*, dogs are to be considered as a source of well-being for the whole community, and thus considered in any real smart city narrative. In this work, the sustainability of dog shelter is described by means of the Emergy analysis, pointing out the difficulties arising from the actual carelessness of the society about the dogs' population life.

THE DOG SHELTER

The Dog Shelter of Rubano (<https://it-it.facebook.com/CanileDiRubano/>), whose entrance is depicted in Figure 1, is located in North-Eastern Italy, near Padua. The Shelter, that does not receive any financial support from the public Institutions, hosts, supports and cure hundreds of dogs every year. These may arrive from citizens, from sanitary structures collecting abandoned dogs, or from other kennels.

The mission of the Shelter is not only that of taking care of dogs remained alone for some reason, but also to operate towards their reintegration in the society, by means of properly managed adoptions. In 2016, The Dog Shelter registered a stock of about 100 dogs living in its campus, an inflow of almost 200 dogs and a likewise outflow, to which another hundred cats should be considered, that have been hosted and then adopted by families. Several tens of volunteers provided about 9,000 hours of free labor, while more than 200,000 Euros were spent for paid labor and services and other production costs. More than 30 events were organized for information and resources collection. More than 2,500 people visit the Shelter every year, and the Facebook page of the Shelter is followed by almost 15,000 people. Table 1 reports the relevant data concerning the Shelter activities.



Figure 1. Dog Shelter entrance.

Table 1. The Dog Shelter by numbers, referred to the year 2016.

THE SHELTER			FOUR-LEGGED GUESTS		
Green areas	sqrm	3770	dogs	already in	94
Boxes	sqrm	680		incoming born	4
First aid	sqrm	8		conveyed	187
Kitchen	sqrm	16		outgoing adopted	175
Offices	sqrm	14		dead	6
Locker room	sqrm	6	cats	incoming	~100
Whole area	sqrm	5200		adopted	~100
Doghouses	nr	106			

LABOR AT THE SHELTER				OTHER ACTIVITIES	
		task	hrs/yr		hrs/yr
EMPLOYEES	2	services and maintenance	4576	Radio advertising	4955
VETERINARIES	2	health care	144	Posts on Socials	228
VOLUNTEERS	40	Dog walks and play	730	Informative stands	186
		Box cleaning	2190	Events and shows	18
		Presence and supervision	2944		
		Welcome and guided visits	1100		
		Adoption beaurocracy	1090		
		Fund raising events activity	426		
		Administration of medicines	365		

Some balance between incoming and adopted dogs must be maintained, since the yearly flows are of the same order of the number of dogs actually living in the Shelter. This means that only an effective activity promotion for the dogs' adoption can allow the sustainability of the system. In general, since the Shelter is not supported by local Institutions, it must activate several strategies of public involvement, both for its needs in terms of labor and services, and for the money required to maintain its operation.

EMERGY ANALYSIS

The emergy analysis (Odum, 1996) has been carried out by taking the data for the year 2016. These data are variable depending on contingencies that cannot be controlled in advance, so they are considered to reflect some sort of "average" year of operation. In particular, the number of incoming and outgoing dogs may fluctuate of several tens, as well as the number of volunteers who are available each year. However, the shelter never rejects new arrivals, so it rearranges its activities such to accomplish for the increase of the number of dogs to care of. As for the money flows, the possible need for surgery and other expensive medical care is often a relevant item, as well as exceptional unscheduled maintenance. For this reason, the shelter financial situation is constantly monitored, and several activities of fund raising are specifically promoted to get over specific situations. Figure 2 shows the emergy diagram of the Rubano shelter.

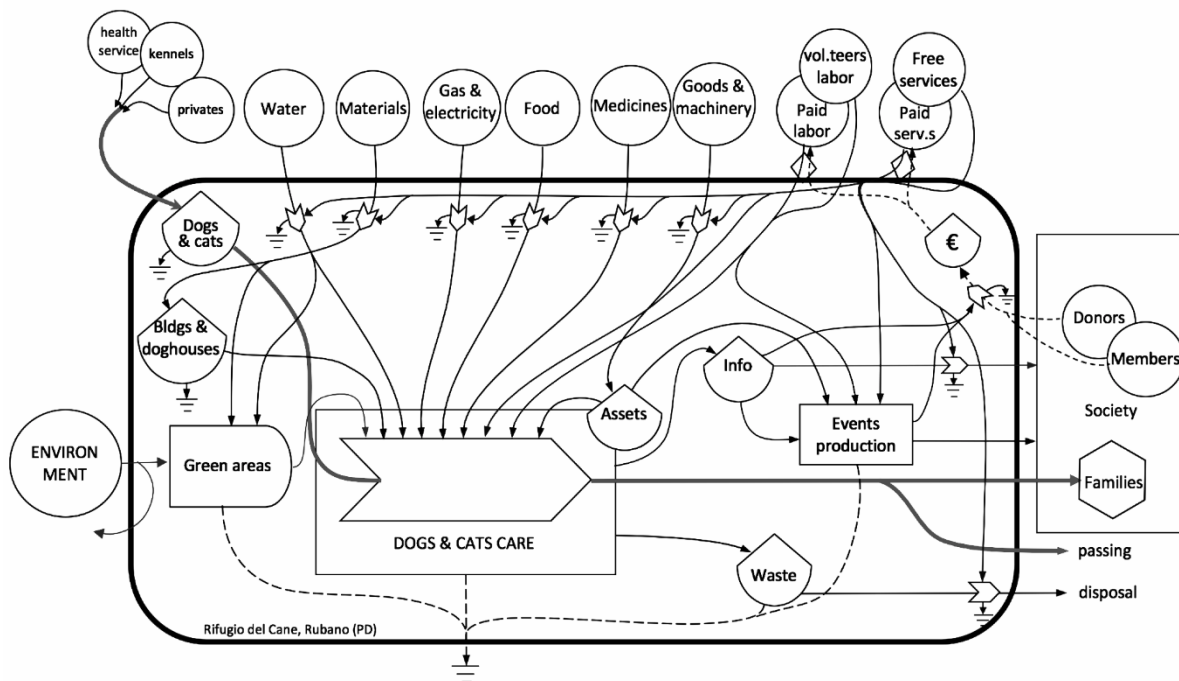


Figure 2. Emergy diagram of the Rubano Dog Shelter.

Although in the diagram the families represent the main end-user of the service provided by the dog shelter, it is worth stressing that the dogs themselves are to be considered end-users as well. As it happens for a hospital, they enter the system for receiving cares and help, and get adopted only when the conditions may lead to a good quality of life for them. An important role is played in the diagram by the “event production” box, representing all the activities the shelter organizes to be known by the general public. The systemic relevance of these events is crucial, since the society is the provider of donations that are activated by the information about the quality of the services guaranteed by the shelter. The information is also spread by means of social posts and radio advertising (see Table 1), with a reinforcing feedback that allows the continuing dissemination of the activities. Table 2 presents the emergy inventory for the Rubano Dog Shelter, with data referred to the year 2016.

From the obtained emergy flows, the emergy needed for the whole care of the “average dog” during one year was calculated, resulting in the surprising value of $1.21E+16$ (sej/dog)/year. The main outcome of the analysis are:

- Labor & Services provide 83% of the emergy;
- food is the most relevant imported resource;
- volunteers provide about 60% of the labor emergy;
- free services are comparable to paid ones.

Being at the same time a non-profit system and a system based on human activity, usual emergy indicators do not provide particularly interesting information. The Shelter appears as a system dedicated to consumption and transformation of purchased resources, with non-renewable resources concentrated in a relatively small area.

Table 2. Emergy accounting table for the Rubano Dog Shelter.

Item	Unit	Amount	Ref. yrs	UEV (sej/unit) [a]	Ref.	Emergy (sej/yr)	
RENEWABLE RESOURCES							
SOLAR RADIATION	J/yr	2.65E+13		1		2.65E+13	
WIND ENERGY	J/yr	2.90E+09		8.00E+02	Brown & Ulgiati (2016)	2.30E+12	
RAINWATER (chem. pot.)	J/yr	2.09E+10		7.00E+03	Brown & Ulgiati (2016)	1.46E+14	
CURRENT RESOURCES							
BUILDINGS & FENCES	Iron	kg	2.05E+04	50	2.27E+10	De Vilbiss & Brown (2015)	9.32E+12
	Concrete	kg	49.74E+03	50	1.96E+12	Brown & Buranakarn (2003)	1.95E+15
	Plastic roof	kg	1.17E+03	50	7.44E+12	Brown & Buranakarn (2003)	1.74E+14
	Stonework	kg	1.83E+05	50	2.95E+12	Brown & Buranakarn (2003)	1.08E+16
	Cement	kg	13.94E+03	50	2.36E+12	Brown & Buranakarn (2003)	6.58E+14
	Gravel	kg/yr	7.16E+03		1.21E+09	after De Vilbiss & Brown (2015)	8.66E+12
Item	Polyurethane	kg	2.26E+03	25	1.91E+12	Buonocore et al. (2015)	1.73E+14
	Aluminium	kg	1.85E+03	25	4.08E+10	after De Vilbiss & Brown (2015)	3.02E+12
	Steel	kg	127	25	5.25E+12	Brown & Buranakarn (2003)	2.67E+13
OFFICE ITEMS	Printers/Fax	n	3	5	1.53E+14	Authors estimate	9.18E+13
	Laptops	n	2	5	7.48E+14	Authors estimate	2.99E+14
	Paper	kg/yr	50		8.18E+12	Authors estimate	4.10E+14
MACHINERY AND TOOLS		n	10	5	1.90E+14	Authors estimate	3.80E+14
PURCHASED RESOURCES							
VETERINARY FOOD		kg/yr	2.24E+03		1.08E+13	[b]	2.44E+16
MEDICINES	All categories	kg/yr	3		3.56E+12	Campbell et al. (2009)	1.01E+13
GADGET	Cotton T-shirts	kg/yr	54		1.02E+13	Authors estimate	5.48E+14
	Paper	kg/yr	321		8.18E+12	Authors estimate	2.63E+15
CLEANING ITEMS	Ammonia	kg/yr	270		1.14E+13	Spagnolo et al. (2017)	3.08E+15
FUEL	Propane gas	J/yr	1.88E+09		1.41E+05	Brown et al. (2011)	2.64E+14
WATER (chem. pot.)		J/yr	2.54E+09		4.08E+04	Brown & Ulgiati (2016)	1.22E+14
ELECTRICITY		J/yr	6.33E+10		4.03E+05	Brown et al. (2012)	2.55E+16
DONATED RESOURCES							
FOOD	Dry food	kg/yr	9.00E+03		9.79E+12	[b]	8.81E+16
	Food cans	kg/yr	3.65E+03		1.20E+13	[b]	4.37E+16
MEDICINES & HEALTH	All categories	kg/yr	120		3.56E+12	Campbell et al. (2009)	4.27E+14
FURNITURE AND GOODS	Wooden desks	n	2	15	6.35E+13	Authors estimate	8.47E+12
	Office cabinets	n	5	15	1.89E+13	Authors estimate	6.30E+12
	Blankets	n	168	3	3.26E+13	[c]	1.83E+15
LABOR							
PAID LABOR		€/yr	89152		2.17E+12	NEAD (2008)	1.94E+17
VIRTUAL LABOR		€/yr	133294		2.17E+12	NEAD (2008)	2.90E+17
SERVICES							
TOTAL PAID		€/yr	131774		2.17E+12	NEAD (2008)	2.87E+17
VIRTUAL SERVICES		€/yr	109370		2.17E+12	NEAD (2008)	2.38E+17
TOTAL EMERGY							
TOTAL EMERGY WITHOUT L&S						2.01E+17	
TOTAL EMERGY WITH PAID L&S						6.82E+17	
TOTAL EMERGY WITH PAID AND VIRTUAL L&S						1.21E+18	

[a] All used UEVs are referred to the Geobiosphere Emergy Baseline of 12.0E+24 sej/yr (Brown et al., 2016)

[b] calculated using NEAD (2008) as sej/€ * €/kg

[c] calculated using NEAD (2008) as sej/€ * €/blanket

SOME CONCLUSIONS

Generally speaking, energy accounting results have pointed out the criticality of a system that cannot define a budget in advance, nor make any reliable prediction about the flows of resources needed for the next year, or even month. Neglected in the narrative about smart and sustainable cities, the communities of dogs should be regarded as part of the citizenry, for biophysical, systemic and ethical reasons, so addressing the activities of the systems appointed to their care also in terms of the formation of volunteers, promotion of the public awareness, and re-integration of the four-legged guests in a family. There is a need for a continuous feedback action between the image of the structure -carried by its own activities and by the public events, and the flow of donations supporting the Shelter, that in turn contribute to increase the quality of the service. As concerns the donations and the labor and services given for free, if they were all related to the information spread out of the shelter, this would mean that the investment of 1 *sej* in publicity give rise to an inflow of 12 *sej* of free resources. Although oversimplified and not quantitatively reliable, this calculation gives an idea about how much the dogs care services lie on the capacity of the shelter to provide an outgoing information flow. Finally, it is worth stressing again that the service provided by the Dog Shelter is twofold: on one hand, the main end users are the dogs, that are hosted, supported and cured; on the other hand, the Shelter has a specific social role in the promotion of the (human) citizens well-being, by taking care of the reintegration of dogs in the social and urban reality.

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