

Modeling pre-industrial urban ecosystems, to aim sustainability

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Abstract. The goal of the research is the creation of sustainable models, to be compared with contemporary municipalities, aiming sustainability. The method of indicator comparisons is promoted by the European Environmental Agency and the European Committee, although that known “sustainable” indicators refer to data from cities that are not sustainable. Identifying the insufficient way to sustainability, the research investigates the function and flows, of 28 autonomous, self-sufficient settlements in Epirus, before the industrialization, based on their cyclical ecosystem behavior, in four fields: political, economic, environmental, and social. The settlements as ecosystems are applied in the DPSIR framework of EEA, giving the perfect function, which concerned political autonomy, self-preservation, a high quality of life and education level, as out-flows culture, legacies, and pan European trade. Therefore, sustainability and cyclical urban ecosystem are indeed identical terms, concerning social, economic, and environmental excellence. The fields are highly interdependent. The basis, or the “Driving force”, for the ecosystemic function to sustainability is an independent-strong local authority, empowered by local economy of the primary sector. These condition in a “green” built environment, is able to achieve strong social cohesion. The ecosystemic-function of the preindustrial models as benchmarks can lead the way to a contemporary sustainability excellence.

1 Introduction

Sustainability is used as a goal of interventions in various sectors. It is a political goal [1], targeted also by academics, architects, ecologists, engineers, scientists, and social groups.

The ability of natural systems to support (sustainability), to maintain life, provide the basis of the term and the goal. The European Environmental Agency (EEA) states that political bodies have misunderstood the definitions of sustainability, and their actions are fragmented and insufficient [1].

For Urban Ecology [2], and the EEA [1], the term Sustainable city and Circular Urban Ecosystem are identical terms. Ecological approach is the consideration of the city as an ecosystem, which however is characterized by its own history, and functions, has biotic and non-biotic components, recycles by converting energy and resources [2]. Also does not outspread, has as out- flows products and culture, with minimal transportation and waste, having as in- flows a small number of products. The function of the city in this form concerns mainly cities and settlements, in the pre-industrial and pre-capitalist period.

The method of indicator comparisons between cities is used by Urban Ecology [2], also promoted by EEA [3,4,5,6], and European Committee (EC) [7], for local authorities. Tools and indicators are promoted from EEA [3,4,5,6,8], and EC [7], aiming sustainability.

The known “sustainable” indicators refer to statistical data from cities [7] that are not sustainable. Identifying the misunderstanding in the terminology and the fragmental way to sustainability, the research studies pre-industrial settlements on their ecosystem function.

The goal of the research is the creation of sustainable models, as standards, for comparisons with contemporary municipalities, and guides to urban sustainability.

The research investigates the function and flows, of 28 settlements of Zagori in Epirus, based on their cyclical ecosystem behavior, before the industrialization and capitalization period, in four fields: political, economic, environmental, and social.

Settlements are the concentration of a population, that practices common utilitarian practices, which are translated into corresponding uses of space. This simultaneously social and geographical unit must necessarily satisfy two limitations, first to be characterized by a relative independence of operation, and second from a relative geographical independence [9].

Based on this definition of self-reliance, the ability to self-maintain (Sustainability), traditional settlements are studied as systems, in terms of the causes of this ability.

The choice to study settlements of Zagori was made because the cultural citadel of Epirus, Zagori lived with autonomy, and self-government, since ancient times, also during the Ottoman conquest [10,11].

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The study settlements concern the eastern, northern, central and western Zagori. The west of Zagori were settlements of Greeks and to the east initially of Vlachs. The west of Zagori, is referred as the descendants of the ancient Epirotes with the characteristic clear speech in Greek and the preservation of the customs and traditions of the ancient Greeks [11]. Of the 46 settlements that belong to Zagori area, 28 were investigated as ecosystems.

2 Methodology

The chain framework DPSIR (Drivers, Pressure, State, Impact, Response) Figure 1. is proposed by the EEA [3,4,6], for local authorities, to investigate and deal with urban issues of their municipalities aiming sustainability. The DPSIR framework was created based to the circular ecosystem. [4].

The 28 settlements will be analyzed in the five faces DPSIR chain framework of EEA to test their functioning as ecosystems but also to discover the causes of self-preservation. The function and flows of the settlements are investigated in four fields political, economic, environmental, and social.

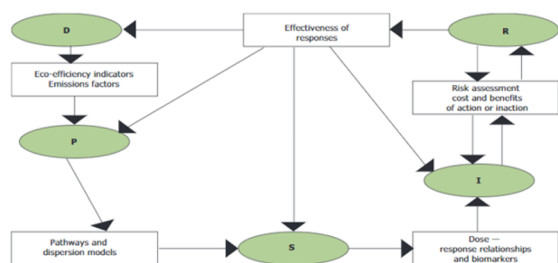


Figure 1. EEA framework, (EEA, 2014).

1st phase: Drivers (D)

Driving Forces (D) are the forces that push or create the occasion for the subsequent pressure (P) [6].

The political condition of the settlements concerned “The Treaty of Voinikos” (1430.) It was an autonomous commonwealth of villages of Zagori in the region of Epirus Greece. According to that agreement the villages would be subordinate to the Ottomans but would retain their autonomy and the management of their own internal affairs, with their own local government [11].

The need for security, due to the circumstances drove several settlements to increase in population by the movement of nearby residents [10].

2nd phase: Pressure (P)

The Drivers (D) as a political condition gave the pressure (P) for all the settlements to create a strong independent community. They had to create resources capable of self-sustaining in barren lands. The preservation of the “local identity” became a self-evident goal for the Zagorians.

3rd phase: State (S)

The settlements status (S) concerns the political, environmental, social and economic structure and function at that time.

The settlements were surrounded by wildlife, and a great variety of animals and medicinal herbs.

Morphologically, consists of plateaus interrupted by rivers and streams. Settlements were built in valleys, at the feet of hills or mountains. Stone buildings, of different designs depending on the location, were surrounded by different types of trees.

In every settlement there were community taps, wells, and rainwater catchments. A tall building with a bell or spire, churches, and many chapels. In the center of the settlement there were public buildings such as inns, workshops, market, butchers, but also a plane tree [11].

All the settlements used local materials, the constructions were made of local stone, and wood. This gave each settlement an “identity” in complete harmony with the surrounding landscape. Bioclimatic architecture, and environmental design in full agreement with the morphology of the land, attributed to a different organic form.

All 28 settlements lived with autonomy and self-government. Each consisted of a five-member community authority (only locals), unpaid, that were held accountable every year to a general meeting with community's residents.

There was special care for the poor and the landless, that were exempted from taxations. There were no social class distinctions. Participation in a “community call” to build or repair community property was self-evident [12]. Those who caused harm to the village or committed crime were treated with negligence, they were silently preached under persecution.

All the inhabitants were Greek Orthodox Christians. Boys' Schools and Girls' schools operated in each settlement [10,11]. The expenses for running the schools and paying the teachers concerned the whole community, resources were legacies, such as buildings, interest or amounts in banks, community resources and church donations. The resources of each community were different, such as rents from land, mills, shops etc. [10,11].

Residents' main occupations were agriculture and animal husbandry. But also, there were literate men and women, teachers, Ph.D. scientists, doctors, merchants, university professors and a lot of national Benefactors [11].

The settlements are analyzed in their State (S) in detail based on their ecosystem function in four geographical areas:

Eastern Zagori [10,11] (Vlach language)

1. Grevenite

Morphology: Mountain village, western orientation, in a verdant and collapsed valley. The land is described fertile and smooth.

Out-Flows, Products: Cereals, very good quality wine, livestock products were exported to Ioannina & Epirus.

Emigration to M. Asia, America, Romania.

Social characteristics: Good intellectual and social development, men and women were almost all literates.

Tuition resources were from Benefactors, community resources and the church.

Living standard: Most of the inhabitants were wealthy, few were poor [10].

2. Flampurari

Morphology: mountain settlement, western orientation, the terrain is uneven and fertile.

Out-Flows, Products: Cereals, livestock products, wine, horticultural items, construction timber. Emigration to Greece, Turkey and America.

Social characteristics: Intellectual and social development was good. Men and women were almost all literate, with many scientists and officers. Tuition resources were from Benefactors and community resources.

Living standard: Some of them wealthy, but many were impoverished by robberies [10].

3. Chernesio

Mountain village, its terrain is uneven and a little fertile.

Out-Flows, Products: Cereals, wine, livestock, and logging products. Emigration to M. Asia, Greece, Romania, and America.

The spiritual and social condition of the inhabitants is characterized as minimal [10]. Most of them were illiterate, with no will for education and patriotism, the residents had no interest for the community. Tuition resources were from Benefactors and community resources.

Living standard: Almost everyone was poor [10].

4. Vovoussa

Mountain village. Its land is little smooth and a little fertile.

Out-Flows, Products: Timber and date were exported to Zagori and other provinces of Epirus [11]. Timber, livestock products, (cattle feed), cheeses (manouri, export to Italy), river trout. Emigration to Asia Minor, Romania, and America.

The spiritual and social development in the settlement was almost good. Almost all the inhabitants were literate [10]. Tuition resources were from contributions, Benefactors, later amounts from the Consulate.

Living standard: Everyone was wealthy [10].

5. Laista

Mountain village, the terrain is described as uneven and barren.

Out-Flows, Products: Wine, cereals and livestock products. Emigration to Macedonia, Thrace and America.

The spiritual and social development of the inhabitants was moderate. There were few illiterates [10]. Tuition resources were from contributions, community resources and donations to the church.

Living standard: almost all were rich but characterized by little prosperity [10].

6. Paleochori Laistis

Mountain settlement, is described as uneven but fertile terrain.

Out-Flows, Products: Wine, cereals, potatoes, livestock products. Emigration to Macedonia, Thrace.

The intellectual and social development was minimal. Resources of the school and the Girls' School

were from community land rents, and an allowance from the Consulate.

Living standard: Almost everyone was poor [10].

7. Dobrinovo

The ground is described as sloping with trees, streams flow, and almost barren.

Out-Flows, Products: Wine, cereals, livestock products, pulses etc. They emigrate to Thessaly, Bulgaria, Vlachia, America.

The intellectual and social development was characterized by Katharios [10] as little. Most of them were illiterate, foreign-speaking, quarrelsome, and the women were antisocial. Tuition resources were from Consular allowance, rents from community properties such as land, mills, shops, and contributions to the church.

Living standard: Many were poor, the rich usually emigrate due to lack of security [10].

8. Lesinita

The terrain is described as sloping, uneven and almost barren.

Out-Flows, Products: Wine, cereals, livestock products, cashews, almonds, hazelnuts, emigrated to Thrace, Macedonia, Thessaly, America.

Social characteristics: Almost good was the intellectual development. Almost all the inhabitants were literate, and willing to be educated. Most were teachers and priests. The women mainly work in local trade, agriculture, animal husbandry due to the traveling of men [10]. Funding for the scholarships was an amount in pounds from the Consulate and from community income. The community resources were rents from land, mill, and the church supplemented by contributions.

Living standard: Neither rich nor poor, in a mediocre situation [10].

Northern Zagori [10,11]

9. Skamneli

The settlement is mountainous, built on sloping ground, stony, a little fertile, without trees.

Out-Flows, Products: Cereals, wine, pulses, and livestock products. In the past it also produced textile and logging products. Emigration to M. Asia, Romania, Egypt, America, Greece.

Very good intellectual and social development of the inhabitants was characterized by Katharios [10]. All were literate men and women, important men are known as scientists, historians, lawyers and philosophers [11]. Tuition resources were from Benefactors and community resources. Important national Benefactors are widely known [11].

Living standard: Almost all were rich [10].

10. Chepelovo

The ground is described as stony and almost treeless. The soil is uneven and, in some places, fertile.

Out-Flows, Products: Wine, livestock products, cashews, apples, horticultural items, pulses, etc. The inhabitants emigrated to Macedonia, Thrace, North Greece, Asia Minor and America.

The intellectual and social development was very good, all men and women were literate, most were scientists, important traders, and publishers [10,11].

Tuition resources were from Benefactors and Community resources.

Living standard: They were moderately rich [10].

11. Kapesovo

The terrain is sloping, stony and barren.

Out-Flows, Products: Vines, beekeeping, livestock and produced excellent wine, livestock products and a few grains. Emigration in Egypt, Athens, Macedonia, and America.

One of the specialties of the region that developed in the 17th - 18th century was icon painting and wood carving with a scope of work throughout Epirus.

The intellectual and social development was very good, men and women were all literate, and most were teachers [10]. Tuition resources were from Benefactors. Important men of the time are mentioned as distinguished lawyer, Prosecutor of Appeals, journalist, PhD of law, philosopher, also the richest merchant of Epirus etc. [11].

Living standard: Few live rich, many were poor [10].

12. Bradetto

The soil is described as uneven and fertile [10].

Out-Flows, Products: Production of cheeses, butters and bryzan [11]. It produced many cereals, livestock products and fruit. A lot of the male inhabitants emigrated to M. Asia and Macedonia. The intellectual development was moderate, there were illiterate men and women, few scientists, but socially they were developed.

Their occupations concerned cattle breeders and farmers. The estates were cultivated by the female farmers [10].

The operating resources of the schools were from community's land rents. Important men are known as the provost who abolished many taxes for Zagori with his influence, teachers, and PhDs of medicine [11].

Living standard: All of them were rich [10].

13. Koukouli

The land is described as sloping, dry, uneven, and barren [10].

Out-Flows, Products: Wine, livestock products, fruit, with exports of cheese [11]. Emigration flows by the travelers was mainly to M. Asia, Macedonia, and America.

Very good intellectual and at the same time social development, everyone was literate in fact several of them were scientists [10]. School resources were from community resources rents from land, and from Benefactors. Important men are known as professor of law, professor of Physics at the National University, rector of Rizario, author of scientific books, philosopher, and theologian professor in Arsakeio, etc. [11].

Living standard: The barren land and the location of the settlement lack of security did not give wealthy residents [10].

14. 15. Vitsa (Ano, Kato)

The terrain is described as sloping, uneven, treeless, arid, almost barren.

Out-Flows, Products: Wine, cereals, and livestock products. They emigrate to Egypt, Macedonia, M. Asia, America.

The social and intellectual condition was good, all were literate men and women, most of them were scientists, merchants, philosophers, professors [10,11].

Tuition resources were from Benefactors and from the church, the community had no resources.

Living standard: Moderately rich, very few were poor [10].

16. Monodentri

The terrain is described as uneven, dry, arid and almost barren.

Out-Flows, Products: Livestock products, cereals. Emigration to M. Asia, America, Africa.

They were socially and intellectually on a good level, almost all the inhabitants were literate except for a few women, several were scientists, engaged in agriculture and animal husbandry (mostly women) [10]. Tuition resources were mainly from Benefactors and very few from community resources. Important men are known as National benefactors, doctors, lawyers, university professors, of philosophy, and PhDs of medicine [11].

Living standard: Moderately rich [10].

Central Zagori [10,11]

17. Sopotzelion

The soil is described as smooth and a little fertile.

Out-Flows, Products: Silk, wine, livestock, cereals. A lot of inhabitants emigrated for security reasons mainly to Egypt, Romania, and M. Asia.

The intellectual and social level was very good [10], all men and women were literate, many were scientists, and PhD doctors [10,11]. Resources for the function of the schools, the payment of the priests and doctors of the settlement were an interest from Benefactor's amount [10].

Living standard: Was characterized moderately wealthy, few were poor [10].

18. Baya

The soil is described as partly smooth, and moderately fertile.

Out-Flows, Products: Livestock, wine, cereals, fruit, potatoes. Emigration flows by the travelers was to M. Asia, Romania, Egypt, Macedonia, Thrace and America.

Intellectual development was moderate, illiterate men and women, the scientists were few [10]. Important men are known as professors of philosophy, PhD of law, PhD lawyers, and doctors [11]. There were Benefactors, but school resources were paid from community and church donations only [10].

Living standard: Many people were moderately wealthy, and few were moderately poor [10].

19. Doliani

The terrain is described as mountainous, uneven and a little fertile.

Out-Flows, Products: They had exports in wine, in various fruit products, especially in apples "sugar apples" as they were called. Emigration flows by the travelers was mainly to Romania, Turkey, and M. Asia.

Katharios [10] mentions that all residents were literate men and women with good intellectual and social development. They were engaged in agriculture, animal husbandry and foreign trade. Important men are known and mentioned by Lambridis [11] as PhD doctors. The school's resources were interest from donor's bonds [10].

Living standard: Moderately wealthy [10].

20. Dragari

Its terrain is described as uneven and barren.

Out-Flows, Products: Chestnuts, livestock products, wine, and logging. Emigration flows by the travelers was mainly to Romania and M. Asia.

The intellectual and social development was described as small [10]. They were all literate but with "low" culture.

The residents were engaged in viticulture, wood carving and the collection of chestnuts. The school resources were from Benefactors.

Living standard: Most of the inhabitants were poor [10].

21. Makrino

The soil is described as uneven and moderately fertile.

Out-Flows, Products: Chestnuts, apples, cashews, cereals, wine, pulses, and beekeeping products. Emigration flows by the travelers was mainly to Romania and Thessaly.

They had good social and intellectual development, all the inhabitants were literate, men and women [10]. Tuition resources for the operation of the schools were from Benefactors, community resources, and church donations.

Living standard: The travelers of the settlement were rich, but the locals were poor because of the robberies [10].

Western Zagori [10,11]

22. Ano Sudena

The land is sloping dry, treeless, anhydrous and uneven.

Out-Flows, Products: Lots of cereals, wine, and livestock products. Emigration to Egypt, western Greece, Macedonia, M. Asia, America, and Africa.

The social and intellectual development was very good. All men and women were literate, and many of them were scientists. Important men are known as national Benefactors, philosophers, prosecutors, lawyers, professors, and PhD of medicine [11]. Resources for the operation of the school were from Benefactors, and community resources.

Living standard: Moderately rich, only few of them were poor [10].

23. Cervari

The soil is described as uneven and fertile.

Out-Flows, Products: Cereal products, livestock, wine, almonds, and curry. Emigration was to Serbia, Greece, Macedonia, Egypt, Romania, and America.

The intellectual and social development was good, all men and women were literate, there were several scientists and teachers. Resources for the operation of the school were from Benefactors, community resources and from the church donations.

Living standard: Almost all were rich, very few were poor [10,11].

24. Kato Sudena

Built on sloping, dry and uneven ground. In some parts of it the soil is described as smooth and very fertile [10].

Out-Flows, Products: Cereals, livestock, wine, and pulses. Emigration to N. Greece, Egypt, M. Asia, and America.

Spiritual and social development was good [10]. They were distinguished by their industriousness, diligence and philanthropic activity. All were literate, many of them were scientists, farmers, breeders and teachers. The resources for the operation of the school were from Benefactors, and community's resources.

Living standard: Moderately wealthy, few were poor [10,11].

25. Dovra

The soil is described as uneven in places and moderately fertile.

Out-Flows, Products: Cereals, wine and livestock products, they had trade mainly in Xanthi, Jenitze, Giamourjina, Athens, and Bucharest [11]. Emigration flows by the travelers was to Thrace, Macedonia, Asia Minor and Egypt.

The social and intellectual development was actually good, almost everyone was literate, most were scientists.

Resources for the operation of the school were from Benefactors, community resources and the church.

Living standard: In prosperous financial condition [10].

26. Boultsi

The soil is described as sloping, uneven, barren, and moisty.

Out-Flows, Products: Cereals, fruit, and livestock products. Emigration flows by the travelers was mainly to Ioannina, Romania, Macedonia.

The intellectual and social development was good. The inhabitants gradually abandoned carpentry and engaged in trade, and most of them became rich. Resources for the operation of the school were from Benefactors, and the church donations.

Living standard: Most people were rich, few people were poor [10,11].

South Zagori [10,11]

27. Drestenikon

The soil is uneven and fertile.

Out-Flows, Products: Cereals, livestock products, wine, fruit, apples. Emigration flows by the travelers was mainly to M. Asia and America.

The intellectual and social development was small, yet almost everyone was literate. They were engaged in agriculture, especially vines and livestock. Resources for the operation of the school were from Benefactors, community resources and from the church.

Living standard: Average, very few of them were poor [10].

28. Papigo (Western Zagori) [11]

Papigo was referred as a town in 1870. There were large settlements, courts, markets, and workshops.

Out-Flows, Products: Wine, almonds, beans, etc.

Since 1781, with community help, two schools have been in operation. Many Benefactors and intellectuals are known, as excellent doctors and ophthalmologists.

Living standard: It was one of the richest and most prestigious in Zagori [11].

4th phase: **Impact (I)**

It concerns the effects that came from the State (S), as natural ecosystems, economy, health, and well-being of people. It can be the result of chain effects, locally to globally [3,4,6].

The Impact (I) of the 28 preindustrial ecosystems produced only positive local and supra-local effects. Zagori reached great prosperity in 19th and the beginning of the 20th century, having spiritual and economic prosperity. Intellectuals and merchants lived and traveled in Europe with great economic wealth.

The out- flows also concerned products several of which were exported to Europe. The sloping and barren land did not stand in the way of self-preservation, even though you meet rocks and rocks again. Western Zagori mostly exported wheat, barley, maize, grapes, the eastern Zagori exported grapes, types of fruits, apples, cherries, chestnuts, plums, walnuts, livestock products, textiles, capes from Pindos exported to places such as Madrid, Marseille, Genoa, Livorno, Messina, Odessa, Palermo, Alexandria, Brindisi, Ancona, Venice, and Trieste [13].

But truly important outflows in most of the settlements of Zagori were educated people, and teachers, possibly because the scholarship students had the obligation after their studies for a few years to teach wherever they were assigned [14].

5th phase: Response (R)

Concerns the efforts for prevention, treatment, and improvement by the local authorities [3,4,6].

Usually in this 5th phase of the framework, the causes of a contemporary municipality's problems and the impacts at local and supra-local level have been identified. The political action (R) must concern actions for an overall response. At all phases, comparisons between indicators are suggested by EEA [3,4,6] for better understanding and the final action of municipality's issues.

At this point, the importance of sustainable models for comparisons becomes understandable.

In the cases of the 28 pre-industrial settlements of Zagori, their operation concerns the perfect ecosystem function.

The Response (R) of the local authorities of Zagori concerned the maintenance of the self-sufficiency ability (sustainability), by targeting the high education of the inhabitance.

Efforts were made from time to time to preserve the rights and autonomy ("The Treaty of Voinikos") of Zagori by prominent men. Even after the removal of the privileges by the Ottomans in the middle of the 19th century, the communities exercised this ability to self-maintain with excellence. The 46 settlements of Zagori formed a perfect aristo-democratic state until the beginning of the 20th century [10,11,13].

Zagorians only concern was to return to their homeland to provide for the family, while delivering culture and luxury. The autonomy and sustainability of the community of Zagori concerned everyone. Eminent Zagorians, aimed granting education, to finance, to help poor boys and girls, to maintain community property above all. The benefactions also concerned the establishment and financing of hospitals, universities,

libraries, and schools all over Greece.

During the 19th century, the gradual retreat of the Ottoman rule begins, with radical rearrangements and disturbances. Population groups assembled in an anthropo-geographical unit were disorganized after their liberation [15].

Since the beginning of the 20th century, the urbanization and modernization-Europeanization of the Greek state was urgent for the Greek governments [16]. After the liberation of Ioannina and Zagori (1913) begins the weakening of local authorities and the end of the ecosystemic function.

Applying briefly, the basic functions of contemporary Zagori political situation and function in DPSIR framework of EEA, the ecosystem function of the framework collapses.

By giving negative effects to Impact (I) since the state (S) has no longer the ability to self-sustain. Application in the framework of indicators after the end of self-reliance:

1st phase: Drivers (D)

After the liberation of Zagori, the state had the responsibility to take care of all the settlements in Zagori, the power of the local communities gradually weakened.

2nd phase: Pressure (P)

The pressure given by the new political scene concerned the weakening of local self-government, giving "demographic bleeding" due to "capitalist integration" and globalization, consequences more than all the events of the war and the civil war together [9].

3rd phase: State (S)

Although the excellent environmental conditions in Zagori remains the same, the bioclimatic architecture and environmental planning of the settlement exists to this day. The excellent environmental status is not enough. Social organization and cohesion are incomparable to pre-industrial models. Also, there are very few schools which underperform since the residents have relocated to big urban centers.

4th phase: Impact (I)

The economy of the settlements is mainly aimed at tourism. The gathering of large crowds during tourist seasons has impacts on the natural systems and resources of settlements, having local and hyperlocal negative environmental effects [17].

3 Results

By categorizing the data analyzed in the DPSIR chain framework into tables we can discover the relationship of the flows and the internal state of the pre-industrial settlements-ecosystems. The sections recorded in the tables concern: the morphology, the flows of the ecosystem, the religion and language of the inhabitants, the social characteristics concerning the intellectual and social development, the existence of schools, as well as the origin of the resources for their operation. The resources concerned, as mentioned in detail in each settlement, community resources and donations from

local Benefactors. The last column finally concerns the standard of living.

Also, with the application of colors in the Table 1., Table 2., Table 3., Table 4., emphasis is placed on the results and the relationship of cultural development with the standard of living. The four tables refer, as in the methodology, to the four regions, eastern, northern, central and western Zagori.

The first superficial assumptions are that despite the barren and difficult to exploit land, each settlement had the ability to self-sustain, producing products, and moreover, several of them were sold at a supra-local level in Europe. The need to create and the abilities of the residents gave out-flows abroad but also in-flows when they returned to their families bringing European culture and wealth to the local community.

In eastern Zagori they spoke Vlach and Greek, as mentioned in the introduction to the west of Zagori were settlements of Greeks and to the east initially of Vlachs. The west of Zagori, is referred as the descendants of the ancient Epirotes with the characteristic clear Greek language in and the preservation of the customs and traditions of the ancient Greeks [11].

By comparing the four tables regarding language, intellectual development and the standard of living, we understand that in the settlements with a stronger Greek identity, the communal cohesion was greater, higher education and finally high standard of living. All settlements had at least one school and a Girls' School. The lessons concerned, among other things, the learning of Greek, French and Turkish language, according to the yearbook of the Epirotians of Constantinople [14].

From the operation of schools with community resources or donations, we understand the priority of the community for education, and the strong community cohesion, without discriminations. Of particular interest is that the very high standard of living concerned settlements with very high social and spiritual development.

The results of the tables are presented with percentages, confirming the results.

Table 1. Function and flows, Eastern Zagori in 1913, based on their cyclical ecosystem behavior. Own processing.

| Settlement | Morphology | Flora | Out/Proc. Products | Language & Religion | Social characteristics (under/over social development) | School | Resources | Living standard |
|---------------------------|----------------------------------|--|--|-------------------------------|--|--------|-----------|-----------------|
| Zagori (1913) | Mountain village | | | Greek & Slav. of Great Greece | | | | |
| 1. Gervasio | The land is fertile and smooth | Asia Minor, America, Romania | Cereals, wine, livestock, wool | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2. Pampouzi | Uneven and fertile | Greece, Turkey and America | Cereals, livestock products, wine, industrial wool, construction timber | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3. Chierischi | Uneven and a little fertile | M. Asia, Greece, Romania and America | Cereals, wine, livestock and lignite products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4. Yermes | Partly smooth and little fertile | Emigration to M. Asia, Romania and America | Timber and date were exported to Zagori and Epirus, livestock products, chestnut, export to Italy-Italy wine | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5. Latis | Uneven and barren | Macedonia, Thrace and America | Wine, cereals and livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6. Pileokaki Latis | Uneven but fertile terrain | Macedonia, Thrace | Wine, cereals, pastures, livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7. Delvades | Uneven and above barren | Thrace as Greece, Bulgaria, Vlachia, America | Wine, cereals, livestock products, jolies | ✓ | ✓ | ✓ | ✓ | ✓ |
| 8. Lavatis | Shrubby uneven and above barren | Thrace, Macedonia, Thessaly America | Wine, cereals, livestock products, cashmere, almonds, hazelnuts | ✓ | ✓ | ✓ | ✓ | ✓ |

All settlements had 100% local production and out-flows, traveler flows and community support capacity.

That is a self-preservation ability or sustainability in excellence. The level of education affects the corresponding standard of living since in Eastern Zagori the growth rate is 62.5% wealthy and at the same time 62,5% educated and social developed.

Table 2. Function and flows, Northern Zagori in 1913. Own processing.

| Settlement | Flora | Out/Proc. Products | Language & Religion | Social characteristics (under/over social development) | School | Resources | Living standard | |
|----------------------|--|---|--|--|--------|-----------|-----------------|---|
| 9. Skanelli | Shrubby ground, above a little fertile | M. Asia, Romania, Egypt, America, Greece | Cereals, wine, pulses, and livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 10. Chelopeva | Stony almost barren. The soil is uneven and above barren | Macedonia, Thrace, North Greece, Asia Minor and America | Wine, livestock products, cashmere, leguminous, apples, horticultural items, pulses | ✓ | ✓ | ✓ | ✓ | ✓ |
| 11. Kapovee | The terrain is shrubby, stony and barren | Egypt, Albania, Macedonia and America | Wine, honey, leguminous, industrial and medicinal products, cashmere wool, livestock products and a few grains | ✓ | ✓ | ✓ | ✓ | ✓ |
| 12. Bradini | The soil is uneven and fertile | M. Asia and Macedonia | Cheese, butter and various cereals, livestock products and fish | ✓ | ✓ | ✓ | ✓ | ✓ |
| 13. Kivkaval | The land is shrubby, dry, uneven, barren | M. Asia, Macedonia and America | Wine, livestock products, fish, Export of cheese | ✓ | ✓ | ✓ | ✓ | ✓ |
| 14.15. Viza | The terrain is shrubby, uneven, stony and above barren | Egypt, Macedonia, M. Asia, America | Wine, cereals and livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 16. Manakina | The terrain is uneven, dry and above barren | M. Asia, America, Africa | Livestock products, cereals | ✓ | ✓ | ✓ | ✓ | ✓ |

In the Northern settlements of Zagori, they spoke the Greek language very clearly, the education level was very high, at a rate of 100%, the percentage of wealthy residents was 85.7%, but not really since the percentage of wealth concern the attacked by robberies due to the great economic prosperity.

Table 3. Function and flows, Central Zagori in 1913. Own processing.

| Settlement | Flora | Out/Proc. Products | Language & Religion | Social characteristics (under/over social development) | School | Resources | Living standard | |
|----------------------|---|--|--|--|--------|-----------|-----------------|---|
| 17. Supetiste | The soil is both smooth and a little fertile | Egypt, Romania, and Asia Minor | Wine, cereals, livestock, cashmere | ✓ | ✓ | ✓ | ✓ | ✓ |
| 18. Bero | The soil is partly smooth, moderately fertile | M. Asia, Romania, Egypt, Macedonia, Thrace and America | Livestock, wine, cereals, goat, pastures, leguminous | ✓ | ✓ | ✓ | ✓ | ✓ |
| 19. Delvazi | The terrain is uneven and a little fertile | Romania, Turkey and M. Asia | Export to Viza, various food products, especially apples 'apple apple' in their own kind, Maltose, wine, apples, leguminous and livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 20. Dragari | In terrain is uneven and barren | Romania and M. Asia | Cheese, livestock products, wine and logging | ✓ | ✓ | ✓ | ✓ | ✓ |
| 21. Michales | The soil is uneven and moderately fertile | Romania and Thessaly | Cheese, apples, cashmere, cashmere, some cereals, wine, pulses, and some horticultural products | ✓ | ✓ | ✓ | ✓ | ✓ |

In the settlements of Central Zagori with an 80% high level of education, there was also 80% economic prosperity. Also, in the settlements of western Zagori with an 85,7% high level of education, there was also an 85,7% economic boom.

Table 4. Function and flows, Western Zagori in 1913. Own processing.

| Settlement | Flora | Out/Proc. Products | Language & Religion | Social characteristics (under/over social development) | School | Resources | Living standard | |
|-----------------------|--|--|---|--|--------|-----------|-----------------|---|
| 22. Anzides | Shrubby dry, barren, arid/stone, uneven | Egypt, Western Greece, Macedonia, M. Asia, America, and Africa | Lots of cereals, wine and livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 23. Cervati | The soil is uneven and fertile | North Greece, Macedonia, Egypt, Romania and America | Cereals products, livestock, wine, apples, almonds | ✓ | ✓ | ✓ | ✓ | ✓ |
| 24. Xasi Tades | Highly shrubby, dry and above barren, some parts of the soil is described as smooth and very fertile | Greece, Egypt, M. Asia and America | Cereals, livestock, wine and pulses and developed a product almost everywhere | ✓ | ✓ | ✓ | ✓ | ✓ |
| 25. Deres | The soil is uneven in places and moderately fertile | Thrace, Macedonia, M. Asia and Egypt | Cereals, wine, pulses, and some horticultural products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 26. Boudi | The soil is shrubby, uneven, barren, stony | Ioniania, Romania, Macedonia | Cereals, fruit and livestock products | ✓ | ✓ | ✓ | ✓ | ✓ |
| 27. Dytanalis | The soil is uneven and fertile | M. Asia and America | Cereals, livestock products, Greek language but with a foreign accent | ✓ | ✓ | ✓ | ✓ | ✓ |
| 28. Pappo | | | Wine, almonds, beans, etc. | ✓ | ✓ | ✓ | ✓ | ✓ |

3 Conclusions

Therefore, in the 28 settlements studied, Fig. 2. all of them had the ability to self-sustain in excellence, all had strong communal cohesion, and the goal to function autonomous. All of them had streams of travelers, that gave by time to time in- flows of culture and wealth.

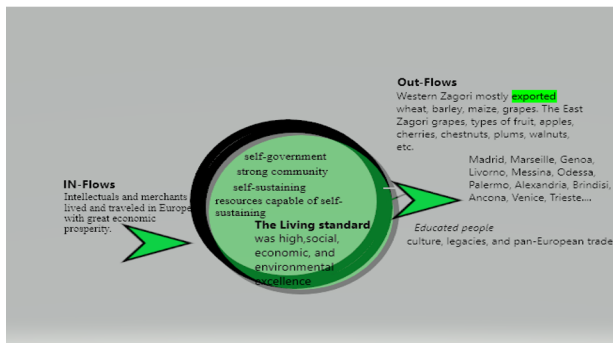


Fig. 2. Modeling the function of preindustrial ecosystems. Own processing.

The high educational level, gave social development and economic prosperity. On a supra local level, the products of Zagori traveled all the way to Europe along with important merchants and highly educated people. Also, the Benefactors took care of their homeland and the nation with extreme donations.

Overall, the application in the EEA, DPSIR framework of preindustrial settlements, gave perfect function as an ecosystem, and supra-local benefits from the out-flows.

The functioning of the settlements until the beginning of the 20th century as ecosystems was not only about recycling, use of local materials, and passive architecture. Furthermore concerned, a high quality of life, self-preservation, giving as out-flows: culture, legacies, and pan-European trade. A very strong social cohesion existed without hindering individual development, also a living level particularly high.

The functioning of the eco-systems was dissolved by the weakening of the local self-government. The green environment and bioclimatic architecture were not enough to sustain the communities, which previously were flourishing economically and spiritually.

The use of local materials gave a morphological identity, which is differentiated to this day, but the strong social ties were removed along with the weakening of the community authorities.

Strong conclusions of the research are that urban sustainability and urban cyclical ecosystem are indeed identical terms.

Sustainability preexisted, as social, economic, and environmental excellence and the fields are highly interdependent.

Consequently, the goal of a municipality must be the ecosystemic function, with tools for determining the urban challenges the DPSIR framework of the EEA.

The fragmental actions aiming sustainability prove to be insufficient, since sustainability exists in excellence of the three pillars-sectors, i.e., environmental, economic, and social.

The basis for the function of sustainability is the independent-strong local authority, empowered by local economy and resources of the primary sector. This condition in a “green” built environment, is able to achieve the social cohesion.

Each municipal authority has the ability to perceive and act, which must be greatly strengthened to be able to

become the Driving force (D) to the sustainable community or otherwise of the ecosystemic function.

Finally, the models of the pre-industrial settlements of Zagori that were chosen for study due to their autonomy and sustain-ability during the period of Turkish rule, gave the way to achieve the sustainable community.

Comparisons of modern municipalities with the sustainable models, in the five phases of DPSIR of EEA, can give the real picture of a municipality since the function of the pre- industrial models as benchmarks can lead the way to a contemporary sustainability excellence.

References

1. M. Mehra, *Towards Sustainable Development for Local Authorities*. European Environmental Agency. Part 1. IMSA Amsterdam. The Netherlands. (1997).
2. H. Sukopp, *On the Early History of Urban Ecology in Europe*. Preslia, Praha. (2002).
3. P. Bosch, M. Buchele, D. Gee, *Environmental Indicators: Typology and Overview*. EEA. (1999).
4. P. Gabrielsen, P. Bosch, *Environmental Indicators: Typology and Use in Reporting*. EEA. (2003).
5. EEA, *EEA core set of indicators Guide*. EEA. Technical report No 1/2005. (2005).
6. C. Maguire, *Digest of EEA indicators 2014*. EEA. Technical report, No 8/2014. (2014).
7. Science for Environment Policy, *Indicators for sustainable cities*. In-depth Report 12. Produced for the European Commission DG Environment by the Science Communication Unit, UWE, Bristol. (2018)
8. EEA, *The European environment — state and outlook 2020: knowledge for transition to a sustainable Europe* (2020).
9. A. Lagopoulos, *The history of the Greek city*. Athens: Hermes Arch. and Arts (2004). (In Greek)
10. S. Ergolavos, A. Katharios, (1913), *Zagorohoria at the beginning of our century*. Rizareion Institution. Ioannina B version (2007). (In Greek)
11. I. Lampridis, *Zagoriaka*. A. Papakosta Continental Library (1870). (In Greek)
12. K. Raios, I. Papavranousis, (1943), *Folklore from Greveniti social organization, Epirotian letters, Period B'. Year D'. 7* (2005). (In Greek)
13. E. Fotiadou, *Epirus and the sea. Epirotian letters, Period B'. Year D'. 8* (2005). (In Greek)
14. Yearbook of the Epirotian Phileducational Association, Constantinople, 1872-1873. Year A, Printing House A. Koromilas (1873). (In Greek)
15. M. Arapoglou, *Residential geography of Epirus*. Techn. Chamber of Greece. Depart. of Epirus, Ioannina (2005). (In Greek)
16. N. Panos, *Renjai, The Kings of Epirus*. ISBN 960-630-896-0. Philippiada (2006). (In Greek)
17. EEA, *Greece country briefing -The European environment- state and outlook 2015*. SOER 2015.