Danube Delta Ecological Restructuring of Traditional Houses and New Designs for Ecological Buildings

Integration with Municipal Infrastructure System and Surrounding Landscape exemplified in Sfistofca, C.A. Rosetti municipality

1. INTRODUCTION

Local and regional development of EU member states in the current context is a theme in continuous progress, presenting many types of challenges and unforeseen difficulties from case to case. And the more the geographical, climatic and geological typology as well as the economic and legal framework are unique and more changing , the more these challenges grow and can make the difference between the potential area and the dead area.

Such unpredictable conditions are given by the Delta area, located in southeastern Romania, northern Dobrogea, bounded by the following geographic coordinates: 45 ° 24'30 "north latitude and 28 ° 10'50" Cat east longitude at Bend, 45 ° 9 '30 "north latitude and 29 ° 42' 45" east longitude East of Sulina, 44 ° 20'40 "north latitude and 28 ° 41'30" east longitude at Cape Midia, 45 ° 27 'north latitude and 29 ° 19'20 "east longitude at Old Chilia.

The modern Danube Delta began forming after 4,000 B.C. in a gulf of the Black Sea, when the sea rose to its present level. A sandy barrier blocked the Danube gulf where the river initially built its delta. Upon filling the gulf with sediments, the delta advanced outside the barrier-blocked estuary after 3,500 B.C. building several successive lobes: the St. George I (3,500-1,600 B.C.), the Sulina (1,600-0 B.C.), the St. George II (0 B.C.-Present) and the Chilia or Kilia (1600 A.D.-Present).

The Danube Delta is a low alluvial plain, mostly covered by wetlands and water. It consists of an intricate pattern of marshes, channels, streamlets and lakes. The average altitude is 0.52 m, with 20% of the territory below sea level, and more than half not exceeding one meter in altitude. Dunes on the most extensive strand plains of the delta (Letea and Caraorman strand plains) stand higher (12.4 m and 7 m respectively).

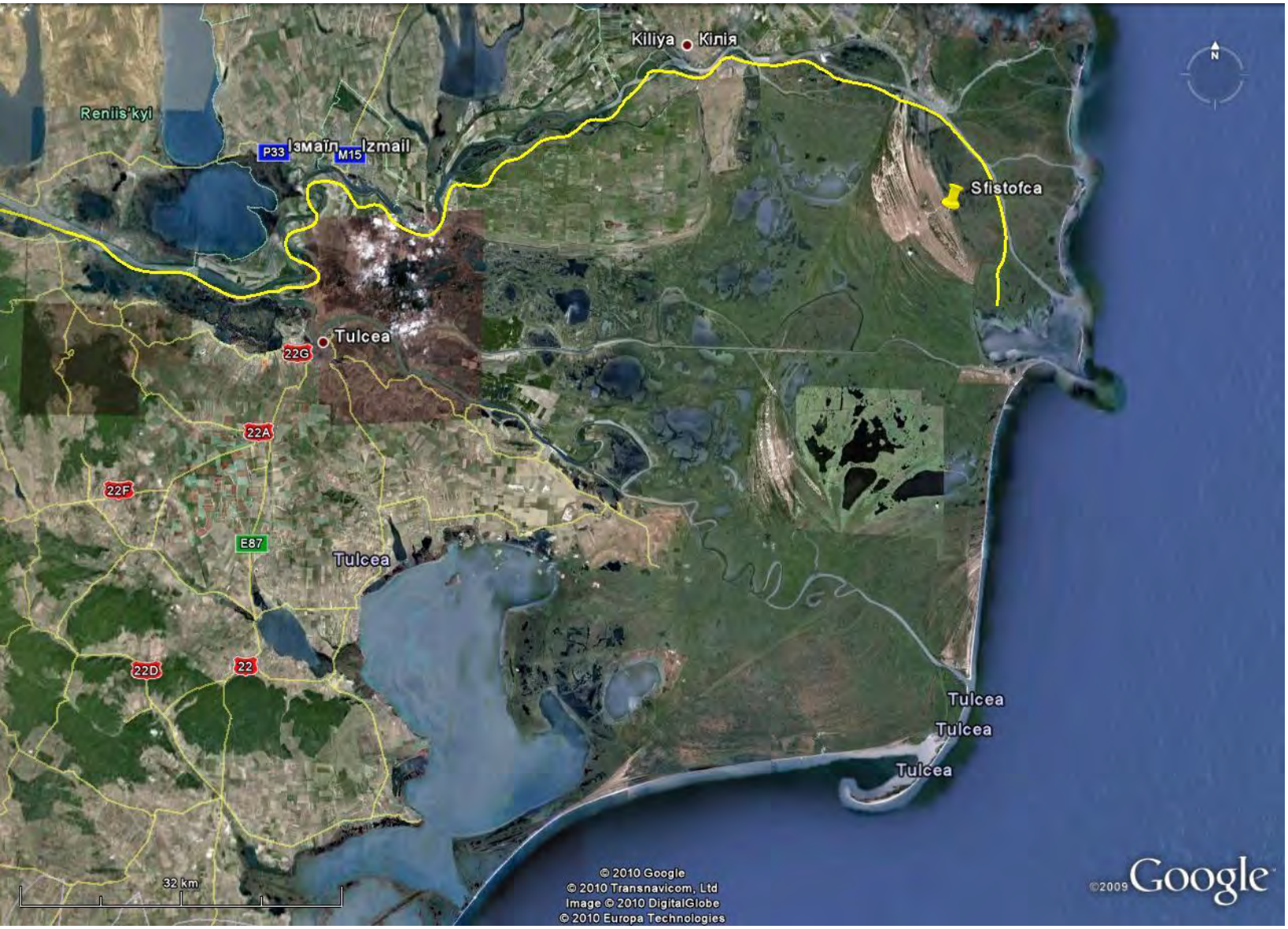
Being the youngest geographical unit in Romania whose first embryo appeared 12,000 years ago, the Danube Delta has the general tendency to be in a long lasting and continuous territorial extension.

This aspect is owing to the accumulation of the alluvia brought by the Danube (45-48 mil. tons/year in the last years) and deposited in front of the three branches (Chilia, Sulina and Sfantu Gheorghe), to the material resulted out of the north-west cliff of the Black Sea and transported by sea currents, as well as to the qualitative change inside caused not only by the allochthon material (alluvia and salts), but also by the autochthonous organic material resulted out of the biological potential of the delta.

In the Danube Delta there has been created a complex, original landscape with a high scientific, aesthetic and economic value, used and changed more and more intensely by man. That was possible by joining the geographical characteristics against the background of the basic processes determined by the Danube River and solar radiation (alluvia and decomposition of the organic material).

Because man's interventions within the delta were done without taking into consideration the fragility of the ecological equilibrium and the special importance of some natural ecosystems, a lot of perturbations have occurred leading to changes in the flora and fauna of this region. Moreover, a great part in the modification of the ecosystems is played by the quality of the Danube waters, which have worsened in the last 3-4 decades, and by the lack of an efficient water circulation inside the delta through the network of streams, canals and lacustrine areas.

Taking into account the present physical-geographical image of the Danube Delta, with a lot of different types of arrangements (agricultural, pisciculture, forestry) with essential modifications in the natural organisation of space and, especially, of the hydrological system by its new statute as biosphere reserve of this geographical unit, it is extremely necessary to analyse the mechanisms of the natural processes for protecting and preserving the components having an outstanding scientific value, for its ecological recovering and utilization of those resources coming out of the delta development as an open system.



2. SFISTOFCA

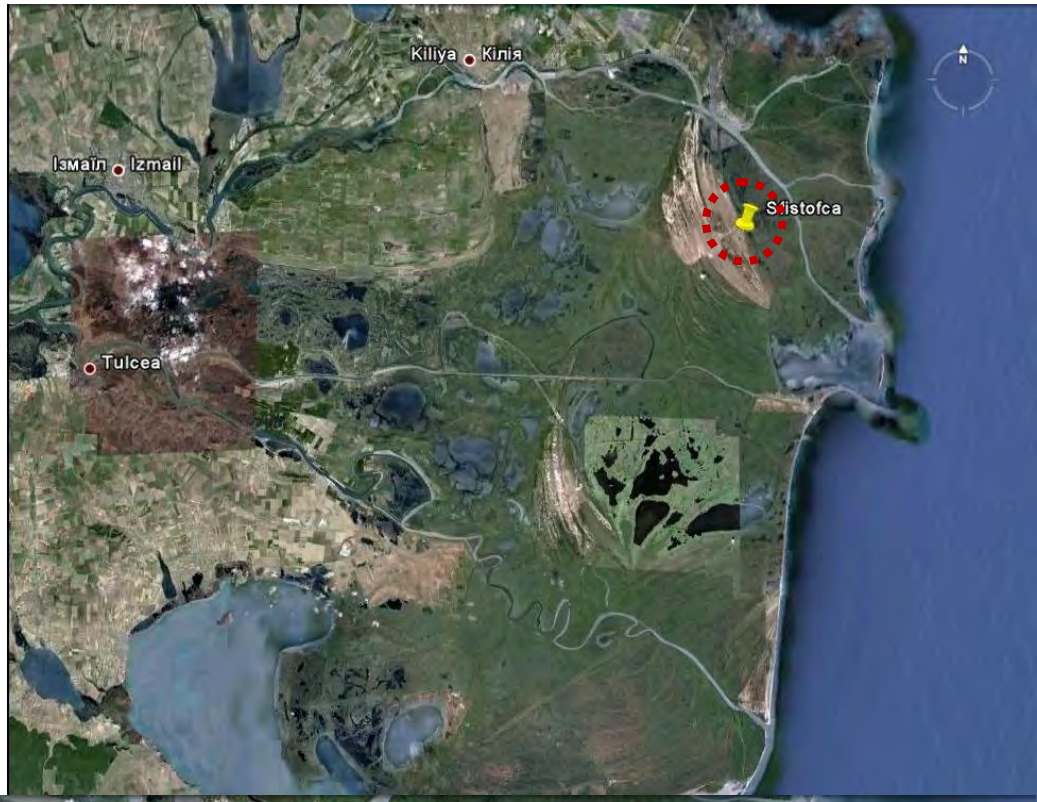
Localization:

Latitude: 45°17'37.16"N

Longitude: 29°35'47.34"E

North-eastern part of Danube Delta, between Chilia branch to the North and Sulina branch to the South

Part of C.A. Rosetti township along with Letea, Periprava and Cardon villages



The village :

- Short history

Prior to being a settlement in the true sense, the area was inhabited by pirates.

Around the 1750 s, when the Black Sea was still covering these portions, the ships often stranded in the silt brought by the Danube, and soon the preying pirates appeared who sometimes lured the sailors with strange whistles, hence the name Sfistofca which is believed to be derived from a strong whistle or swish.

Starting with 1921, along with the Orthodox schism in Russia, there was an influx of Slavic population, mostly fishermen from the Don, and there was an important demographic growth that peaked in the 70s during communism, when it featured a total of 900 inhabitants.

The socialist period was characterized by a large-scale development in this area, driven by plans to maximize the local national production and which created a significant number of jobs but also important human sacrifices.

To create the necessary conditions for activities of various types, there had to be created an electrical infrastructure and an artificial channel bordering the eastern side of the village.

The latter was not an easy thing to do because it involved the transportation of work force from the communist prisons in order to build the dikes.

A large number of political prisoners worked on dams at the cost of their lives, many of them being buried on the site.

Picture - What remained of the former concentration camp Periprava

After wards, there were brought Pedology and Agro chemistry specialists for advanced studies of the soil, exploring the possibilities of reconditioning and desalinating the soil and the behavior of cultures in the local environment. A temporary research station was built, but there was no more time and resources to implement any solution which resulted from these studies.

After the fall of communism in '89, all activities have ceased, the production was stopped, jobs have disappeared, the young generation migrated to Sulina or Tulcea the school closed because there were not enough children, and consequently, the village was in natural process of economic, demographic and aesthetical degradation.

The 90s meant the privatization of many institutions, factories, estates at a national level and from that point, the area was no longer interesting , because environmental conditions are not favorable and it takes great effort with unsure results to embitter them.

- Current situation

Today, after successive changes and activities undergone up till 1989, after land privatization in the coming years and population migration to the city, the village is in a state of slow decline, here living only some dozens of families with petty perspectives.

The current main problem is access. The village as well as other villages in the area, are very isolated from the main navigation paths, the only viable link being Sulina, represented by an unfinished communal road of low quality, and the channel made in the 70s and 80s, which. Not being maintained on certain portions is clogged and presents difficulties in navigation.

Without easy access, the area is virtually nonexistent for potential tourists and prevents future development before even being planned.

The second problem is the lack of water infrastructure.

Picture - aborted water treatment station

The water supply comes from the 3 or 4 water wells from the outskirts of the village and non-drinking water used for household and gardening is taken from the channel.

There was an attempt to build a pumping station to render the water potable near the canal but it was not completed because of inconsistent administration but on the other hand, a surprising reason: the locals themselves did not want it Because that would have meant paying for the water consumed and anyway they would have taken it from wells in which water is free.

Without these facilities, future tourism projects will have to be equipped with its own mini-stations, which will involve expenditure and additional procedures.

The head offices of the C.A. Rosetti city hall said that this issue is being processed, waiting for a superior decision from Tulcea .

Land use :

- **What are still practiced land uses?**

  - **Agriculture** : Not in the true sense. Only subsistence level agriculture reduced to garden dimension resulted within the plots.

  - **Fishing** : Is still present beyond the channel, near lake Popina, but this isn't under the local municipality administration

  - **Others** : No other functions except housing..

- **What land uses got lost in the last decades?**
  - What were land uses before?
  - Describe what processes were related to these uses?

1950s - agricultural activities began up North near Periprava

1953 – Vineyard to the West, towards the forest. Destroyed in 1979 due to inconsistency of production that arrived in Tulcea.

(1972 – 1989) – Fishing activity in Popina, to the East, beyond the channel

At some point livestock farms were present North near Periprava.

Basically, Sfistofca served strictly as residential area which accommodated the workforce that was active in all these production areas East, West and North respectively.

- **What future land uses are feasible?**

- Virtually any operation that functioned in the past could work again in the future.

- In addition**, tourism** can be implemented, **leisure activities**, **rehabilitation centers**, **agro-tourism**, provided the basic utilities are assured in advance (drinking water, efficient wastewater treatment, waste management, and especially easy access to area).

Small corn plantation in Sfistofca household. Proof that small scale agro-tourism is feasible.

2. BUILDING in SFISTOFCA

1) Required changes in terrain to build houses :

- **Lifting the ground level for building projects**

    - Because this area shows no increased risk of flooding, land raising is not imperative.

- **Stabilizing issues of terrain according to current building regulations**

    - Stabilization of land in this area may become a necessity when it comes to building with 1-3 floors high. Case in which a geotechnical study to be made to assess the degree of intervention necessary to increase the resistance and density of the earth.

- **Provide small artificial canals for cooling the terrain in summer**

    - Provision of a water circuit in a development is not difficult to implement in terms of regulations and legal procedures, but it must be fully justified.

    - Such a solution worthwhile only for larger ensembles, in which, the units are numerous and distanced from each other.

    - This requires a treatment and pumping station which could use the channel water input, circulate it efficiently and return it back in the channel.

    - This feature thus requires a high constant maintenance cost that has to be counterbalanced by a substantial profit from only a large-scale development.

    - But evaporative cooling can be easily obtained by providing pools or ponds, cases in which investment and maintenance costs are much lower.

2) Water system and related challenges :

- **Drinking water and use-water supply**

- This issue can have two solutions:

General:

Installing a water purification plant to collect water from the nearby canal; feature executed by the municipality

Isolated:

Drilling of wells of considerable depth, given the saline nature of the area, to capture the fresh water from groundwater and pump it through stations to the individual units/households within the ensemble.

The difficulty of this approach was, however, is that the favorable catchment areas of freshwater are few and scattered over the village, due to the immediate vicinity of the Black Sea which accounts for general salinity of subterranean layers.

- Use water can be provided from the canal water, roughly treated for non-potable uses.

- At this point, the character of the sandy soil is a great advantage in the sense that drilling and excavations are made much easier, no need for large equipment, these being transported easily and generating low cost from this point of view .

- **Sewage treatment and toilet facility**

  - Wastewater treatment will be performed through mini treatment plants, designed according to the number of people accommodated, and supplementing accordingly.

  - Average price for such a plant is somewhere between 2500-4000 €.

- **Water level across the year, flood risk and droughts**

  - Not being located along major waterways, flood risk is minimal. And the channel's dike is sufficiently high.

  - Drought, however, is relatively felt.

  - Rainfall scarcity, salinity and sandy nature of soil are factors that worsen and prolong the effects of drought.

  - Any intake of meteoric water passes quickly through the sandy surface layers not being retained long enough to ensure maintenance of significant crops.

  - However, areas that present severe drought effects are more obvious to the north.

  - Fortunately, the neighboring channel ensures a minimum intake of water for irrigating individual gardens, the only limitation being of human nature, as there are no pumps to facilitate this process.

3) Design principles of using the houses of Sfistofca(according to different groups of users) :

- **Family summer house**

  - During summer
  - Autumn to spring

  - Usually, summer houses in cold season are closed, especially in remote locations like Sfistofca where winter further isolates settlements due to poor transportation infrastructure.

  - However, it can still function as accommodation late into October and November when fishing season is still ongoing.

- **Managed retirement facility**(e.g. elder people, burn out temporary programs, handicapped persons, others)

  - During summer
  - Autumn to spring

  - This type of program can only function from spring to autumn, given the target clients sensibility for cold temperatures and locomotion limitation.

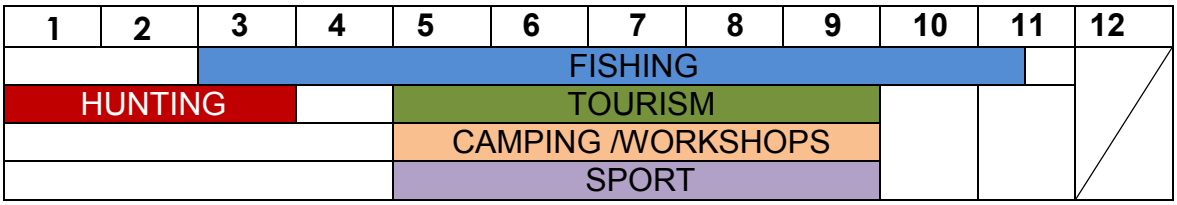
  - Also, there is a decrease in elder people who wish to spend time in a retirement facility, unless there is need for additional medical attention.

  - Given the program's medical nature, it could function as local medical clinic in parallel with its main function of retirement facility, and in winter when this function ceases, it could continue as medical clinic occupying only a part of the building.

- **Excursion center for experience tourism**(trained fit people, student excursions, sport training groups)

  - During summer
  - Autumn to spring

  - This program is most suitable for the Danube Delta region because it offers an array of options all year around in return for decent resilience on the target user's part.



  - Summer period :

    Touristic activities can encompass various types at the same time:

    1) Eco themed camping with earth building workshops

    2) Other workshop themes

    3) Sport activities such as Kayak Canoe . The neighboring channel is suited for such an activity , not being so trafficked and with no strong currents

    4) Agro- tourism in combination with fishing.

  - Autumn to spring :

    Beginning with October till November pike fishing is practiced

    January – March : hunting season. The building could function as hunting lodge

3. MODULAR STRUCTURES

- **Single small houses**

  - Why were there several small units built in the traditional style ?
  - What was the functional connection between small buildings ?(living area unit, storage unit, small bath unit)

  - Traditional houses of the Delta (and others) the main functions were scattered in the land for hygiene reasons, primarily because these remote areas there is no sewage network.

  - ***The Rural Euro Barometer*** - A comprehensive research on the material situation of the inhabitants of "the country", their perceptions and values, conducted in 2005 on a sample of 1516 people revealed that upon EU accession :

    91% of romanian villagers are not connected to natural gas heating grid
    84% had no sewage grid
    85% of Romanian villagers have their toilet in the back yard

  - The three functions: the night, living area - kitchen and bathroom are completely separated from each other in the plot in order of expressiveness and intimacy positioned relative to the street.

  - Near the primary access, the night area is usually located, perpendicular to the street :

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- In the background, if not behind that was living- kitchen area:

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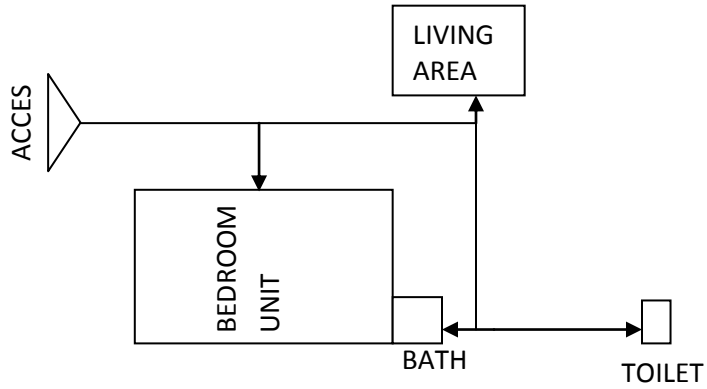
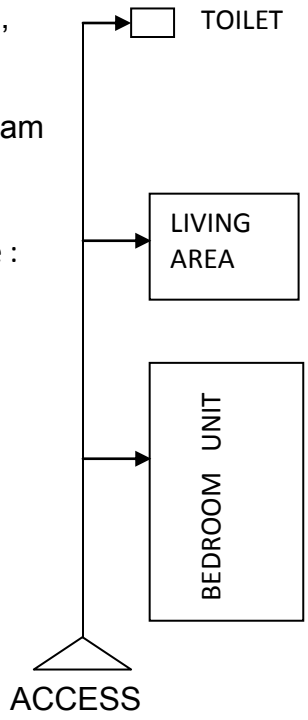
- And way behind, in the back of the yard, the toilet is located :

- The bathroom, usually located adjacent to the living area,
  Hot water is obtained through boiling
  and where sometimes a sauna is improvised
  in which water is poured on burning river stones, and steam is created.

Variations of functional layouts of a traditional deltaic house :





- **Big houses**

  - What would be the advantage/disadvantage of building large units (150sqm)?
  - Are there historical ideas/models of big ensembles?

  - The only justification for building large units would be if the functions of interest have luxury amenities such as indoor swimming pool, spa treatments etc. salons.
  - Disadvantages:

    - It requires a considerable foundation, designed based upon a geotechnical survey (especially in an area such as Sfistofca)

    - Being completely centralized, no activity can begin until construction is completed. (As opposed to a pavilionary ensemble where modular development can be done, adding new modules later, while (touristic)service is already running)

    - It is not specific for delta region. Both in aesthetic and affective terms.

  - *Examples of large assemblies can be found only in production programs or Periprava concentration camp.*

- **Ways of integration**

  - How single small houses can be combined to one ensemble using traditional materials?
  - What is most cost effective: combining small units or building a larger unit?

  - Modular approach can be implemented with ease as long as the land is large enough and an easy flow between the units can be achieved.

  - As mentioned before, the advantage of combining several modules into a whole ensemble, is that the execution can be done in phases, realizing the first main module and some of the secondary units, operating the building not depending on the total number of units initially planed.

  - An execution schedule is thus formulated, in which, for example, during the building process of 1- 3 modules, supplying and preparation of materials needed for the next modules is carried out (e.g.: the clay bricks needing a dry time of 40 to 60 days)

  - From this point of view, even the shipment of materials (from Tulcea, Sulina Mahmudia) can be staged according to execution schedule.

UNIT 1 *- ready*	**UNIT 2** *- ready*	MATERIAL PREPARATION →	**UNIT 5**	**UNIT 6**	MATERIAL PREP.
MATERIAL PREPARATION →		**UNIT 3** *- building*	**UNIT 4** *- building*	MATERIAL PREPARATION →	**UNIT 7**

  - This staging is in correspondence with difficult logistical conditions for this case, where transportation will be difficult for large cargos on existing routes (more details in the "Logistics").

  - In terms of quantity-cost ratio, the option of building several units would require a larger amount of material in long-term, but compensates by segmentation and possibility to discontinue further development anytime.

4. MATERIALS

- **Way to harvest natural materials, describe how it works**

- **SOIL / CLAY :**

In the Danube Delta region, clay for construction is primarily used in two forms:

UNBURNT CLAY+STRAW BRICK locally called " *CHIRPIC* ".

The chirpic is similar to adobe, in which it consists of a mixture between clay, organic material (straws usually) and traditionally, some manure, which is put into molds of 40x25x13cm and dried in the sun for 30-60 days depending on weather conditions.

CLAY+STRAW MIXTURE used as **PLASTER** also called " CIAMUR ".

This plaster is about 5cm thick and covers the internal and external faces of *fork*-type walls which consist of framed reed (more on this in the following subtitle).

For both types, the initial preparation is the same :

Clay and sand is gathered from a moderately greasy soil, mixed together with water and straws until it has achieved a decent plasticity after which it is either put into a mold and dried or used on site as ciamur .

Preparing of chirpic bricks in Adamclisi village in Constanta county, Dobrogea

- The plaster clay-straw mixture is applied directly on the frame walls and binds with its reed component.

Ciamur plaster seen on a deteriorated house in Sfistofca

- **WOOD :**

Wood material in the Danube Delta isn't very abundant in general.
The only forests of considerable size are near Caraorman between Sulina and St. George branches and Letea forest which are protected areas.

This is why, the wooden elements that constitute the building structure of most houses in the region, are mostly unfinished tree trunks and branches as they are found in nature, rudimentarily cut and put in position.

So, viable wood sources are not local and reach location via Tulcea.

Rudimentary timber frames within a fork-type wall – Letea village

- **REED :**

Reed represents the most abundant natural resource available in the delta, the favorable biologic conditions created through the permanent presence of water, encourages luxuriant growth.

Like no other natural resource, reed forms part of the ecology and economy of the Danube delta - as important habitat and natural clarification plant on the one hand and as a versatile raw material on the other, fact that is well reflected in the traditional architecture.

The Danube Delta is indeed the most compact reed surface on the globe (approx. 240000 ha)

Reed harvesting can be done in two ways :

Manual :

In the manual harvesting, the reed is cut in bundles - in the same way it is being done in the mechanized harvest. Manually, the reed bundle is tied up with a reed belt at 0,60m distance from the base, where the circumference of the bundle is around 1-1,5m. The bundle was and still is the conventional unit of measurement of reed. Its average weight is 10kg at the conventional reed humidity of 15%.

The manual reed cutting is made using “tarpan”- a kind of sickle, which is firmly tied up to a long helve by a metal wire. Other tools used for this purpose are “rizeasca” and “cobilca”.

The productivity of the manual reed harvest was low due to the rough working conditions (marshy, frozen or flooded surfaces).

Mechanized:

The necessity for the mechanized harvest of reed evolved especially from the demand of the cellulose industry. It was expected to rise in demand up to 500.000 tons of reed/year, while a human harvester could produce just 35 tones of reed/year.

There are some main steps in the mechanized reed exploitation: harvesting the reed in the field using specific equipment, transporting it to a temporary storehouse, building up reed stacks, compacting the reed (manual or mechanized), loading on special fluvial ships called “ceam”, and transporting it on the Danube River to the consumer, where it is manually or mechanically unloaded.

The basic equipment in the mechanized reed harvesting is: the tractor, the harvester and the crane.

Taking into account the uneven terrain, the most important detail for a vehicle is the driving system, which shifted, over time, from caterpillar to low pressure tires, called PJP - non destructive for the terrain and especially for the reed rhizomes.

- **SAND :**

Sand is the most visible element of this part of the delta, covering the whole area Letea - Sfistofca - Periprava-Cardon, clearly visible in satellite imagery.

The sand is ubiquitous because the whole area was formed from silt brought by the Danube on one hand, and because a long time ago the Black Sea stretched over this area .

The sand is extracted from places with little vegetation, is sieved through of impurities, and is used as component in earth based mixtures used for constructions in different quantities depending on the recipe: for example, unlike *chirpic* the cob has a concentration of 50-80% sand. And also used for mortar and cement mixing on site.

Vast sand dunes in Letea Forest

- **Particular properties, advantages and disadvantages of materials** (in general, and with regard to Sfistofca)

  - SOIL or CLAY building materials
  - WOOD building materials
  - REED building materials
  - SAND building materials
  - OTHER building materials

  - **CLAY** based materials have a few advantages and disadvantages:

    Clay brickwork has high thermal mass. If a building with internal clay brickwork walls and concrete floors is subjected to a heating and cooling cycle that crosses the comfort zone, the brickwork and concrete will maintain a relatively stable level of heat energy for an extended period.
    In summer, they will remain relatively cool and in winter, the same building will remain relatively warm.

    Clay bricks can often be reclaimed for re-use when a building is demolished.

    Contrary to popular belief mud bricks are not good insulators. Since they are extremely dense they lack the ability to trap air within their structure, the attribute of bulk insulation that allows it to resist the transfer of heat.

    Clay walls are capable of providing structural support for centuries but they need protection from extreme weather (e.g. with deep eaves) or continuous maintenance (the ancient structures of the Yemen have been repaired continuously for the centuries they have been standing).
    As a general rule, clay needs protection from driving rain (although some adobe soils are very resistant to weathering) and should not be exposed to continuous high moisture.

    A house may require around 10,000 bricks, but a working couple would be lucky to average a production rate of 200 a week.
    Mud brick moulds can be made from wood or metal. Bricks must dry evenly to avoid cracking and they should be covered to avoid direct sunlight and overly quick drying out.

    Referring to Sfistofca specifically, the clay content must be transported from Periprava, local soil being to sandy for traditional *chirpic* bricks at least.

    If Cob is chosen, perhaps local soil would function, given the high sand content present in cob mixtures.
  - **WOOD** use must be restrained to the structural frames of the house (besides other roof finishings and patios)

Wood is also pretty lightweight facilitating transport and as long as it is properly treated, it does not show significant problems.
As mentioned before, in Sfistofca vicinity wood is pretty scarce.
Wood must be shipped from Tulcea.

- **SAND** ,as previously mentioned, must be sieved before using as mixture component for clay based materials or cement.

- **REED** building materials

Due to its physical characteristics reed is an ideal construction material: It is firm, but light; it keeps the warmth and absorbs the sound and it can be perfectly combined with other materials like loam, lime, wood or concrete.

A particular issue with reed is the metal wire (binding the single reed halms together) if it is necessary to resize the panel.
Knowing about the problems of today's reed-products, the Center for Appropriate Technology in Vienna (GrAT) is performing tests and studies in order to optimize several attributes of the product. Therefore, alternative ways of binding were tested. This includes the use of several types of glues, additional compounds and fixation techniques.

Examples: Test panel combining reed halms, cellulose flakes and stabilizer-glue, a kind of glue based on natural resin and normally used to tighten walkway surfaces made of sand.

- **Eventual use as an export product**

  - SOIL or CLAY building materials
  - WOOD building materials
  - REED building materials
  - SAND building materials
  - OTHER building materials

  - Using exported products, by definition goes against the basic sustainability principle of using local materials.
  - In so doing, additional embodied energy is added to the product from transportation costs and energy use.

  - CLAY based materials cannot be transported on long distances simply due to the fact that it is sensitive to temperature changes, humidity variations etc. and it could arrive deteriorated. Besides the fact that no one would buy clay products if they are already available on site.
  - Same goes with SAND, and WOOD is scarce anyway.

  - The only valuable and plentiful export material is **REED :**

    Reed is exported mainly for roof works

    Roofing reed demand sample
    6mm diameter , height from 150 - 220cm,
    in bundles of 60cm circumference
    at approx. 3€ / bundle

    But also for walls, insulations, and flooring

    Transportation is carried out through trucks of 90-110 m^3.

    The advantage of reed export, and implicitly it's low price, relies in its light weight.

5. LOGISTIC PROBLEMS

- **How materials required from outside will reach Sfistofca and what would be expected price?**

  - Locally available materials?
  - Materials to be transported by boat (from Sulina, Tulcea, Vienna)
  - Materials to be transported locally by road (from Periprava or Sulina, or in combination with ferries from other places)

  - The only available resource around Sfistofca is sand. It is a very thin grained sand and needs to be sieved from impurities.

  - Materials shiped form Tulcea can arrive on site by two ways :

    Tulcea – Periprava
    Tulcea – Sulina

    In both cases there remains additional distance to cover to reach Sfistofca, which can be done on land or on water.

  - From **Periprava,** the route on land is difficult, the whole distance being sandy, as this is not even a communal road but simply a pathway which goes alongside and through the forest.

  - Approximate distance from **Periprava** dock to **Sfistofca** is about **15.6 km**

- This option means passing through C.A. Rosetti, because from here the pathway is flanked by forest, offering shade and occasional shelter.

- Water transport on this route is more facile, the only mention being that the channel doesn't lead straight in Periprava itself, choosing an intermediary docking point in the vicinity of the former concentration camp and fishing basins to de S-E of the village.

- So here there are two choices:

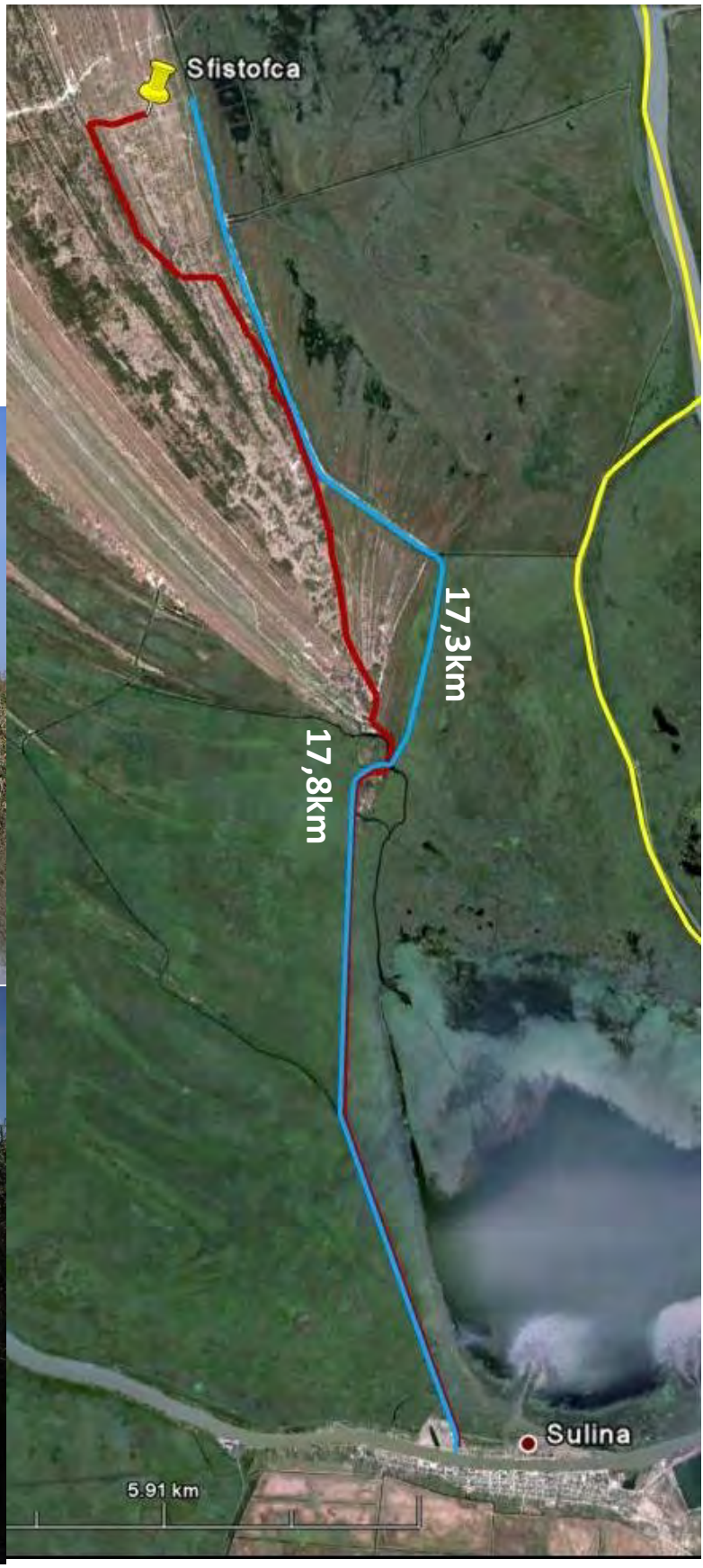
  A. Sfistofca – Dock 1 - Periprava Dock: 9km water + 4.8km land =13.8km
  B. Sfistofca – Dock 2 - Periprava Dock : 11,6km water + 2.8km land =14.4km

- As can be observed, water transportation is preferred, being both shorter and obstacle free, as long as the motorboat has a decent propeller engine that could pass through clogged portions of the canal.

- Plus, clay is procured from Periprava

- From **Sulina,** the land route is relatively better on the portion near Sulina, but it worsens in the second half, towards Sfistofca.

- The water route is similar in quality, the first half from Sulina, the canal is completely cleared from vegetation, but near Sfistofca clogged portion appear.



- Concerning local price of transportation, it is negotiated on site, depending on quantity, volume and route.

- Practiced transportation prices on the main waterways Tulcea – Sulina, Tulcea – Periprava vary according to type of goods

- Some key examples :

    - Burnt brick : 14€ / m^3
    - C.A. Brick : 30€ / m^3
    - Thermal Insulation(extruded polystyrene) : 8€ / pack
    - Timber : 38€ / m^3

- **How to maximize the use of inside materials in accordance with current building regulations?**

    - There are presumed conflicts with the developed traditional style and general building regulations: what are the key concerns?

    - The main issues derive from the fact that Romania is situated in a seismic area, especially the Eastern part of the country.

    - Because of this, load bearing structures are dimensioned accordingly (thicker) and the materials used must withstand horizontal stress besides gravitational.

    - Traditional techniques and materials were not designed and chosen with earthquakes in mind, but upon availability and simplicity, especially here in the Danube Delta region, where there hard/flexible materials such as strong wood or stone are scarce.

    - Examples of centuries old earth-based constructions around the world are still standing because of two reasons: walls are incredibly thick – 1 to 3m in some cases, and they are in non-seismic areas.

    - Earth derived materials can withstand gravitational stress of buildings up to 2-3 stories high but horizontal stress is problematic, and for this reason it is not permitted to be used for load bearing structures according to romanian building code.

- A recurrent problem with earth based materials is that they cannot be standardized, because they depend on so many aspects: soil type, component concentrations, additives, etc. And thus, values for compressive strength for example, vary from place to place. State conducted testing and analysis is necessary in order to ratify clay as structural building material.

- However, as long as the clay material is not used for structural purposes, but only as filling material within the structural frames(composed of concrete, metal or wood), it wouldn't pose a problem.

- The difficulty relies in the fact that wood cannot withstand the heavy load coming from a dense earth type wall filling, unless the wood sections are big enough, and in so doing, what economy would lie in using earth as building material, would be counteracted by a surplus in timber quantity.

- In Greece, there are examples where the usual concrete frame structure is used in combination with earth based filling, but concrete is not allowed in such a setting as Danube Delta.

- So most probably, earth material use would be limited or at least composed and treated(with additives) optimally in order to reduce thickness and weight as much as possible.

- **Other problems like skilled labor force in place**

  - Ex.: reed processing specialists are getting rare
  - People knowing how to mix clay and other constituents are getting rare

  - These are not big issues. There is still a considerable population in the delta region and within Tulcea county with knowledge of these skills and working able and the clay mixing technique is easy to learn and (equally important) easy to improve on.

  - Reed processing specialists are never getting rare due to the fact that the reed business is always active given the high demand from European countries like Holland, Italy or Germany of reed products for roofing, insulations and other uses.

- **Non fitting price ratio: e.g. Polish wood houses are perhaps cheaper than building a local clay house.**

    - This is a very relative subject because it relies on different types of factors.

    - First of all, it should be taken into consideration that clay is used only in walls . Which account for only **25%** of the total building cost.

    - Most of the other 75% goes into the roof, after which windows and doors, appliances etc.

    - Secondly, earth building is very labor intensive.
      This is why about **50% of the final cost is labor cost**.

    - In most cases around the world, these types of constructions are done in a DIY (do it yourself) fashion, owner labor being almost 75%.

    - In order for the investment to be efficient, workshops and voluntary work force should be encouraged. This would be a good theme for summer camps and an additional complementary philosophy to agro - tourism and unique in the area.

    - If initial investment cost is key, most probably earth material use would be restricted to plastering of wood frame (fork-type) reed walls which would be also sufficiently economic and also light.

    - Local examples of wooden house prices :

      200 - 330€/ m^2 - executed bare without finishings (45days)
      400€/ m^2 – executed with finishings (100 days)

    - There are no offers on clay buildings. The only approximate figures are temporal

      6-9 months dry time for **Cob** constructions (because of wall thickness and composition – 25-30% clay + 75% sand, little or no organic material)

      1-2 months for local ***chirpic*** **clay+straw dried brick**.

      * Some gypsies claim a price of **0.12€ / brick**

6. RENEWABLE ENERGY/ RESOURSE SYSTEMS in connection with future constructions

- **Energy**

  - **Photovoltaic**

    Photovoltaic panels are suitable for this area because according to the *Danube Delta Zonal Territory Development Plan* done in 2008 on the Danube Delta region, average annual general solar radiation increases from West to East from 130kcal/cm^2 to 135kcal/cm^2.

    Also, the average annual number of days with clear sky is in slight increase from West to East : Tulcea(66days) – Sulin,St. George (80days)

  - **Heat/ Cold insulation**

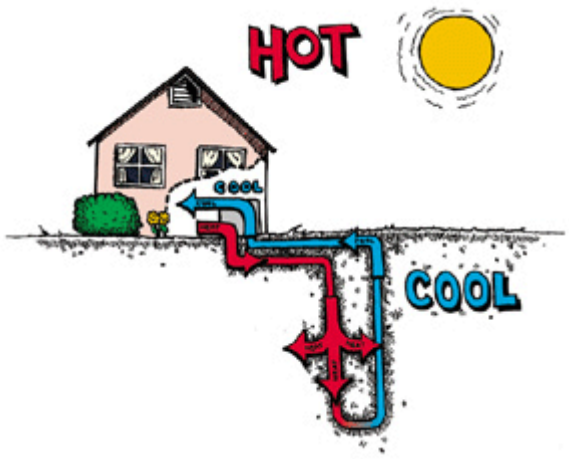
    Insulation is key in this region, given the hot summer period prolonged by scarce vegetation and exposed sand which radiates heat received from the sun on one hand, and on the other hand, the cold dominant blizzard-type wind which blows from N-E (Ukraine)to S-W.

  - **Geothermal**

    Geothermal energy could be applied to the output of heat pumps.
    As mentioned before, drilling should be easy to do, given the sandy upper layers of the soil.

Picture - Drilling machine

Given the earth's steady 12 - 20°C annual temperature at 1.5 - 3m depth, vertical heat pumps are recommended. Horizontal ones are cheaper but they are not as efficient and occupies garden surface.



Biomass for heating

Biomass heating is the closest applicable option in terms of financial and technical terms for such a remote region. Especially since reed would be used, which is abundant in the delta and is known for its high caloric value. Reed would be used in this way in the form of compressed briquette, increasing caloric value further and saving space

Picture - Briquette samples

- **Wind power**

Although Dobrogea is one of the best places for wind power usage, the Danube Delta Biosphere Reserve strictly prohibits turbine installations in its territory.

Insulations

Another use for reed is insulating products. Because of air trapped inside its core and also its fibers, it makes reed an excellent lightweight and ecological thermal insulator.


Pictures - External reed thermal insulation

- **Energy Infrastructure**

  - Put energy into local net in times of production
  - Take energy from local net in times of need
  - Possibility to produce autarkic energy supply independent form local net

  - The current infrastructure in the Danube Delta is in upgrade process and could take some time to accomplish in order to be able to facilitate bidirectional energy transfers between consumer and provider.

  - In July 2010, the Energy Regulations Code has been re-edited on the initial Energy Law (220/2008) approved in 2008 concerning renewable energy systems, and one of the modifications states the possibility of the consumer becoming temporary provider through the use of green energy sources.

  - The implementation of the new code needs, however, more than 45 approvals, must pass through 20 institutions, and it could take anywhere from 18 months to 3 or 5 years.

  - In practice, to be able to put energy into the net from surplus user generated energy, a net metering system has to be installed, invertors to transform AC-current to DC current and vice-versa, and a special billing contract between consumer and provider, from which the consumer could either be paid for surplus energy provided, or simply be billed less in general for kW of electricity.

- Regarding autarkic energy supply, it is rather difficult but not impossible, the difficulty relying in the storage technology used.

- Currently, the traditional method is to store surplus energy in the form of Hydrogen, derived from water through electrolysis, the resulting Hydrogen being stored in tanks.

- A problem might arise in the permission of using such installations in rural setting within the Danube Delta Reservation and if not, the initial investment cost of such a system.

- **Heating and cooling infrastructure**

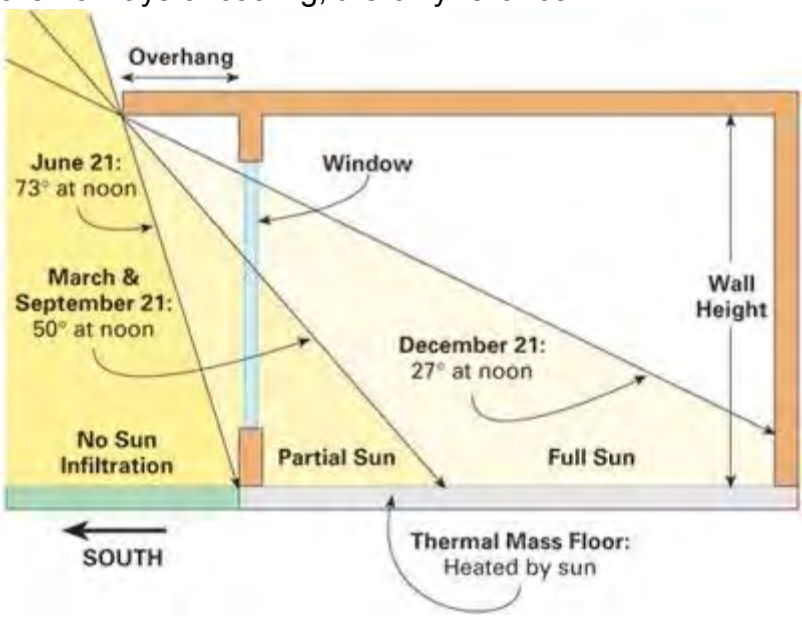
  - Current ways of heating
  - Improvements to current ways of heating
  - Current ways of cooling
  - Improvements to current ways of cooling

  - The current method used for heating is using stoves using whatever solid fuel source is available (wood and reed)

  - The only improvement to this method would be using reed briquettes if not upgrading to a small biomass heating unit.

  - In the hot season unfortunately there are no ways of cooling, the only reliance being on the insulation quality of the household and vegetation.

  - Here there is ample room for improvements adopting passive cooling techniques such as : wider overhangs of the roof, deciduous trees small pools, eaves and good cross ventilation.



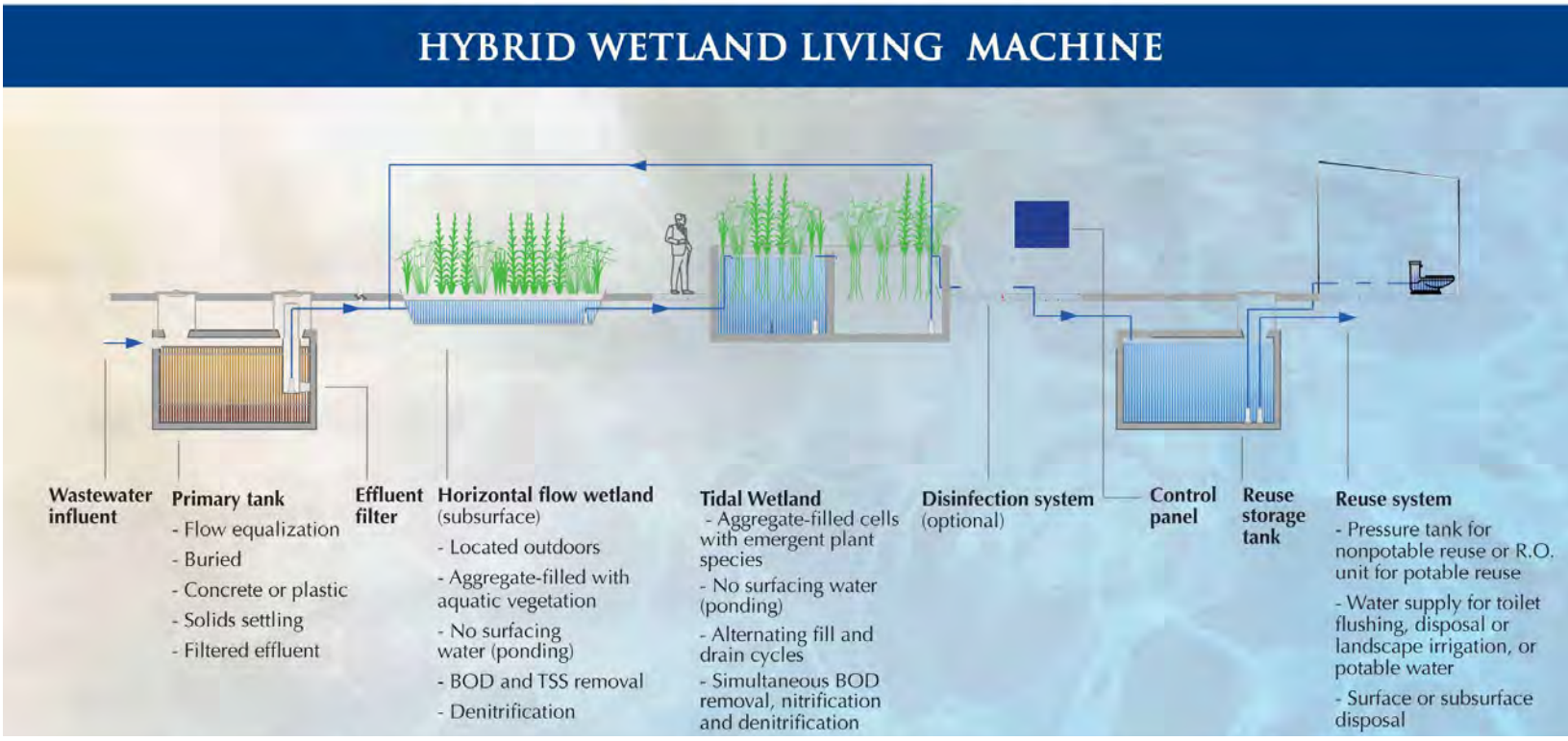
- **Water**

  - Purification potential of Danube water
  - Purification of sewage (vegetation treatment system)
  - Dry toilets, use of human manure
  - Collecting rain water

  - The Danube water has good treatment potential due to the fact that the delta itself acts like a filter, at the end of it, the water being of better quality that at its starting point. As mentioned in the beginning of this report, the municipality made an attempt to install a purification station near the channel but it was aborted.

  - Treatment of refuse water is normally done using mini-purification stations, dimensioned according to number of persons within the household , it costs somewhere near 2000 - 3000 €, and it's bacterial based.

  - Vegetation treatment systems or constructed wetlands , are ecological wastewater treatment systems that mimic processes found in wetland environments. It could be implemented but is suitable for large developments.



Model of constructed wetland treatment system

- Dry toilets are easy to implement, however use of human manure is not used because of human diet.

- Rain water collection in this area isn't sufficiently justified because of the low number of rainy days. The annual average number of rainy days decreases from West to East : Tulcea 104mm, St. George 88mm , Sulina 87.3mm

- A rainwater tank will cost (in 2007) a minimum of $500 for a small 400L
- Regular maintenance, such as checking and cleaning gutters is required.

- **Water infrastructue**

- Input and output of drinking water into/from local water supply of Sfistofca/Rosetti
- Possibilities to organize an independent sewage treatment

- The drinking water input/output ratio isn't clearly defined, mainly because few households in Sfistofca are connected to the water grid. It being present only around the church in the center.
- Most villagers prefer using water from the local wells.

- Indeed, an independent sewage treatment is not only feasible but recommended also, because reliance on municipality to solve the issue is not an efficient option in rural areas and more so in a remote location such as this one.

- **Waste**

- How is waste handling undertaken in Sfistofca households?
- Approximate volume of waste per household/person
- Composting and use of compost
- Possibilities of improvements

- Waste handling in rural areas such as this, is undertaken based on possibilities, most of the villagers not gathering waste selectively, simply into a barrel or recipient, and upon filling they take it to the local waste platform.

- Waste quantity per household is usually small, about 2 3 times less than an urban household. A 50-70l barrel/recipient filled in 3-4 weeks.

- Composting is recommended in this area, giving the soils nutrient-dry nature, although domestic cattle and horses are few.
  But, giving the, sometimes, high population of wild horses (and cattle to some degree) in the delta region, this issue could be solved.

- Improvement possibilities would include **selective collection of waste**, perhaps even a **small communal recycling station**, given the remote nature of these villages, therefore assuring a small amount of basic materials derived from recycled source constantly available.

- **Waste infrastructure**

- Provision of waste disposal in municipality
- PET bottle problem and possible use of PET bottles
- Large waste collection e.g. used refrigerators, TVs, etc.

- The municipal waste disposal unfortunately consists of open, unenclosed platforms for each village.

- Sfistofca has its platform situated in the South West area, with a surface of 0,02hectars, at a distance of 800m from residential area.

- PET waste in these areas is not so alarming, due to the fact that it's not yet an active developed touristic zone. Most of the waste in rural areas is of animal origin, after which biodegradable waste, and plastic, metal, glass in less quantity. The only use is recycling.

- Large waste collection ,as well as quality waste disposal solutions, will be assured as soon as the ***Integrated waste management system*** ,which currently is being implemented in Sulina, reaches C.A. Rosetti municipality

- **Threats to future**

  - Collapse of existing buildings
    (natural integration and reintegration into landscape)

The issue of built degradation is generalized within the Danube Delta, and acute in remote areas such as Sfistofca.

This is due to number of factors :

- Rudimentary construction techniques and materials
- High maintenance demand of clay based material.

  Because of its sensitivity to humidity, and prone to shrinkage, cracks appear regularly and if exposure to frequent humidity is not taken care of, humidity penetrates further endangering structural stability resulting in collapse.

- Abandoning of the village, when will the village be empty if no other activity will be found?

  The current population of 80-100 people is expected to be reduced to 0 in a few decades given the number of elder people and the general migration trend of younger population towards urban environments.

- What has to be foreseen to avoid this?

  Strategies of delaying or avoiding this outcome include promoting touristic and/or production activities and creating incentives for tourists as well as for the local population to remain here or at least return here regularly.

7. CHALLENGEING CONCLUSIONS

- Sustainable future projects (and life style) along with historical development

Future developments in the current European context have to account for two aspects : **sustainability** and **community involvement.**

While sustainability is a generally desired feature, globally and especially specific to fragile environments like the Danube Delta, community involvement is an often overlooked aspect, and for remote, demographically deteriorating areas such as Sfistofca, it is even more important.

Therefore, every new development should create local public involvement first and foremost, through **jobs.**

Additionally, **incentives** must be created in order to generate interest in the area.. Ordinary touristic programs are not powerful enough to achieve this.

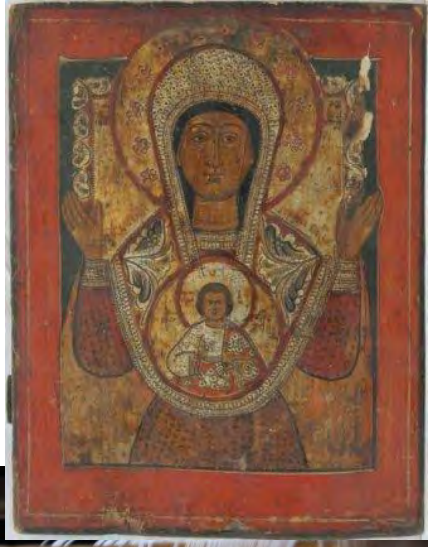
These incentives must be of a different kind and of complementary value :

1. **Cultural incentives** (reading, small theatric plays)
2. **Artistic incentives** (traditional crafting)
3. **Competition incentives** (sporting activities)
4. **Fun incentives** (dancing, games, amusement park)

all of which generate in turn:

5. **Social incentives**

Cultural incentives can be easily achieved by endowing the village cultural center with a library, low-end computers, a small stage for theatric plays which could take place within seasonal rural festivals. Or by proposing a new center built from scratch.



Artistic incentives could be assured by proposing traditional crafting workshops within the cultural center or within a new summer camp establishment.

These crafts include: (religious)painting, pottery, weaving clothes and accessories, etc.

Competition incentives could mean a great deal for this region, being a collective activity by definition, and provoking people to closer interactions.

One particular sport that is suitable to the delta region, and that gave birth to one of Romania's national sports heroes, is **kayak canoe.**

The peculiar fact is that, even though Ivan Patzaichin, multiple kayak canoe Olympic champion , comes from one of the Danube Delta's villages, this sport is not sufficiently promoted and encouraged locally.

Picture- Young Ivan Patzaichin in a canoe

This type of sport can be successfully implemented in Sfistofca, having a small low-trafficked, low-current channel, in which such an activity is more than welcomed.

Fun incentives in the past rural environments were created in the form of seasonal dancing and amusement customs, in which young people met and new couples were made.

Even rudimentary amusement installations were improvised for children and teenagers like fun wheels

All of this is possible and would be unique in the region.

This coupled with a temporary open air dance fair could entice villagers to have some leisure activity to look forward to after a day's work.

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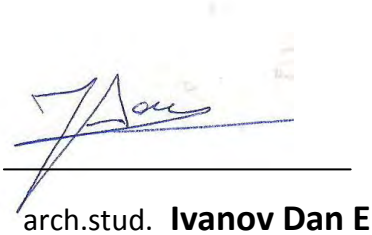

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