

IMPLEMENTATION OF ENERGY EFFICIENT PRINCIPLES OF TRADITIONAL VOJVODINA HOUSE ON THE CONTEMPORARY FACILITY OF LOCAL MONOCULTURE FARMING SYSTEM

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Abstract. *The research is concerned with the current problem of depopulation and devastation of rural areas in Vojvodina, which are slowly disappearing as more and more young people turn to cities and urban lifestyle, looking for more comfortable working conditions not related to agricultural activities. These villages, along with their unique rural architecture, represent the identity of the area and by destruction of their communities Vojvodina would lose on its significance and identity. On the other hand, the paper considers one of the problems of today's research practice that relates to the constant attempts and needs of interpolating agricultural production into already overbuilt and polluted urban surrounding, making the villages even more neglected. Therefore, there is a need to establish a single strategy that would enable the revival of valuable rural communities in Vojvodina and make these areas better and more advanced places to live, retaining agriculture within the rural boundaries, as well as preserving the authenticity and tradition of the Vojvodina region.*

This paper presents the study project of Local Monoculture Farming System as a concept of a visionary model for the new type of facility in villages of Vojvodina whose construction could prevent further departure of young people from these areas giving them the possibility of education and employment within buildings instead of working on the land, since this is one of the reasons why they leave. Relying on energy efficient principles of traditional Vojvodina house in the construction, but also adapting some new, modern sustainable technologies, this future-oriented farming system would enable the connection between traditional and modern in rural areas of Vojvodina. The project links agriculture, energy efficiency, heritage and architecture to recover and use local resources of Vojvodina villages as a cultural approach in contemporary research for sustainable modern solutions.

Key words: *energy efficiency, agriculture, rural areas, Vojvodina, heritage, contemporary architecture*

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1. INTRODUCTION

For more than two decades villages in Vojvodina have been exposed to depopulation under the influence of modern processes of urbanization and industrialization. Rural population recognized salvation from hard work on agricultural land in urban areas, where they expect more comfortable working conditions in activities related to economy, industry and technology. As a consequence, more than half of the total population of Vojvodina lives in cities today, although almost 90% of its territory are villages [1]. The results from two last population censuses, which have been conducted in 2002 and 2011, reveal a constant decrease of rural population in the region. In 2002 rural population of Vojvodina comprised 43.27% of the total population, and in 2011 this number was already reduced to 40.64% [1]. According to Estimates of the population in the Republic of Serbia on 30th of June 2017, the percentage of rural population in Vojvodina has even more decreased to 39.66% [2]. Certain sociological characteristics and patterns of behavior, typical for the traditional rural society in Vojvodina, like stability of relations, unity and equality, represent greatest values of this area. By moving to cities people have lost their social relations that represented an important support for them, while they lived in villages. The identity of Vojvodina is defined by its rural communities and the unique rural architecture. If these local communities disappear, Vojvodina will lose its identity.

"The village was an inexhaustible source of power for the mankind, throughout the history. Much was taken from it and a lot less returned. The village has never been the subject of serious care and work. The main part of spiritual and material efforts and activities was intended for cities. Science and art, the highest domains of man's creation, have not given anything to the village."[3]

The problem of today's research practice is that most of the attention is devoted to trying to solve the problem of overpopulation in cities. Besides many proposals for "insertion" of new facilities in order to solve the housing issues in towns, there are also intentions to move and interpolate agriculture within the polluted city cores, e.g. the project "Farming the city" [4]. Not much effort has been invested in the development of rural communities and returning people to the village, which would also solve the problem of overcrowded cities. Abandonment of agriculture is also one of the consequences of depopulation of rural areas in Vojvodina. However, since it has always been main economic activity and source of income in this region, it is necessary to keep it within the boundaries of rural areas, whose environment will provide natural and sustainable farming conditions. Agriculture requires consumption of large amounts of energy, so the rationality of its production and consumption has a major influence on economic development of rural areas. The need to incorporate environmental protection and application of sustainable development principles in new directions of agricultural and rural policy in Vojvodina is growing.

Traditional rural houses in Vojvodina, which represent bearers of its culture, are specific in certain characteristics that make them sustainable and are built according to energy efficient principles. Unlike contemporary architecture, these houses did not use large amounts of additional energy because everything that was needed for their functioning was found in the local environment, in the natural and the renewable resources. Comparing modern architecture with the traditional, it can be concluded that it's not as sustainable today as it was before. For this reasons it is necessary to examine and reconsider old principles and building technologies of traditional architecture and apply them in new, contemporary

solutions, which would all together enable us to see old architecture in a new light, in the conditions of modern society.

This paper presents the project study proposal of Local Monoculture Farming System (LMFS) as an original idea of the author Jovana Stanišić¹. LMFS shows the concept of the proposed strategy for improving economic and social situation in villages of Vojvodina by recovering and reusing its local resources and applying modern sustainable technologies. This strategy reflects a new approach in contemporary research of sustainable solutions for the future generations. As a future-oriented visionary model of a new type of facility in the villages of Vojvodina, the study project of LMFS would establish a rural-urban synergy by making these rural communities sustainable and more advanced places to live. The purpose of constructing this facility is to preserve agriculture within the rural boundaries in order to improve and facilitate working conditions for the rural population, by giving them new opportunities of employment and education in the villages. Simultaneously accommodating five different functions under the same roof of this facility: farming, manufacturing, promotion and sale of one particular crop, as well as agricultural education of young people, work in agriculture would be greatly simplified. The village would be "urbanized" in a certain way and would adopt a more urban lifestyle. By reusing the old principles of energy-efficient construction of traditional Vojvodina house, but also by applying some of the modern, sustainable technologies, LMFS study enables the reconciliation between traditional and modern in rural areas. Within this paper the study of LMFS construction and functioning system is explained, as well as implementation of energy efficient principles. In order to maintain authenticity of Vojvodina rural communities and not to disturb ambient values of the area, the paper explores the possibilities of adjusting this new facility to the existing environmental conditions of Vojvodina villages: its morphology, urban structure, plots and houses shape, features of traditional architecture etc. Since the aim is to integrate this new type of building in the wider framework of the neighborhood, the analysis of its adjustment is based on one of the existing typologies of Vojvodina houses, typology depending on the relationship between the house and the plot [5]. As a result of these analyzes, several model types of this facility will be formed as a new building typology of LMFS in rural areas of Vojvodina.

¹ The LMFS study project is one of the element of the PhD thesis "*Urbanistic and architectural principles of energy efficiency of traditional Vojvodina houses - application in contemporary architecture*" by author Jovana Stanišić. The important issue that the PhD research is considering relates to the process of depopulation of rural areas in Vojvodina and the degradation of traditional Vojvodina rural houses. Within the theoretical part of the PhD thesis, the problem and reasons of depopulation of the villages were analyzed and defined. The basic goal of the PhD research is to prove that the urbanistic and architectural principles of designing traditional rural houses in Vojvodina are energy efficient, in order to stimulate awareness of the need to return the old principles of construction and their application in contemporary architecture, as a strategy that would enable the revival of these rural communities. The LMFS model is an experimental study of a contemporary architecture project on which these traditional principles are applied in order to examine and demonstrate the possibility of their application. The paper presents the initial phase of the LMFS project development, which includes the formation of general LMFS model types. Further research that involves the implementation of the LMFS concept on specific examples of Vojvodina houses is planned within the PhD thesis.

2. METHODOLOGY

The LMFS project is an experimental study model for examination and demonstration of the possibility of applying the traditional principles of sustainable Vojvodina architecture in the contemporary one. First part of the paper describes the predicted functions of the LMFS project, using the descriptive research method. The second part presents the study of possible architectural features of the LMFS model, through the presentation of an extensive typology and its shaping process, which was carried out using the modeling method, based on previously performed analyses. For example, general plan types of LMFS model have been developed based on previously analyzed types of one of the existing typology of traditional Vojvodina houses. All LMFS model types are designed by applying the examined energy efficient principles of traditional Vojvodina architecture. Finally, all applied principles are schematically shown on the model's figure. The methodology of this paper implies a research-by-design approach, the result of which can be considered more practical than theoretical.

3. LOCAL MONOCULTURE FARMING SYSTEM STUDY PROJECT

LMFS represents an example of BIA (building-integrated agriculture) practice application that explores synergies between the built environment and agriculture by locating greenhouse farming systems on buildings. The BIA system is usually considered in urban areas due to the lack of farmland in cities [6]. Implementation of this practice in the villages of Vojvodina, urbanizes them and brings them closer to the city lifestyle by providing new opportunities of employment and education to young people within the built structures. This method would change the rural tradition and the established rule that in villages only land serves for work, and not buildings. Applying the energy-efficient principles of traditional Vojvodina houses in the construction, these facilities preserve the local tradition and maintain sustainability of its communities. LMFS building involves the production, processing, consuming and trading of one specific agricultural product and its seedlings at the same time. In addition, the agricultural education of young rural population is organized within the facility, in order to enable them to apply their knowledge in their one household later on. Agriculture is integrated inside the building in such a way that all four phases of the agricultural goods life cycle (production, processing, consuming and trading) are carried out within it and the order of these phases is organized according to the levels of the facility, so life cycle of the culture and the building make an inseparable union (Fig 1). That is one of the reasons why the priority is given to the production of agricultural goods within the boundaries of LMFS, instead of using the land. There would be several facilities of this kind built in one village of Vojvodina and each of them would enable the

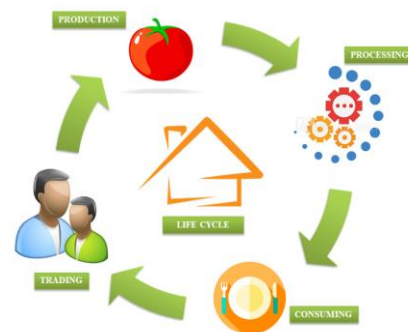


Fig. 1 Agriculture life cycle in Local Monoculture Farming System building (Source of illustration Fig. 1: author's drawing (Stanišić J.))

production of one certain type of agricultural product. Each of these buildings would function as a small, self-sustaining, energy-efficient farming system in rural areas.

3.1. Farming system functioning

Employment of young rural population in these new facilities of LMFS in the villages gives them an opportunity to get a job, to learn activities related to production, processing and trading of agricultural products and its seedlings and, later on, to become independent and start manufacturing within their own households. New young people would come to take their place afterwards and so the whole process of "a social program" would be rounded: employment, training and independent entrepreneurial development. In order to ensure that the project is successful, different key players should be engaged, experts in farming and manufacturing. Young people are the ones who are currently employed and trained, but later on, when they start an independent manufacture, other family members would also be hired. In this way the problem of unemployment of rural population in general would be diminished, regardless of the age of participants. In order to simplify the whole process of production and processing, the plan is to establish a number of such facilities in one village, with only one crop produced within each of them. The LMFS makes it easier for employees to master one particular job and to specialize about the production process of one product. This system allows easier equipping of the space for manufacturing cultures because it is necessary to purchase equipment for processing only one product. Young people who want to learn about the agricultural production of more than one type of product can be educated in several different LMFS buildings. In this case, they are educating for a while at one workplace and then referred to another. Although it is only one culture that is produced inside the building, the processing would yield a variety of products. These products are promoted in a restaurant, which can be located on the ground floor of the facility allowing visitors to consume and familiarize with the final products of a particular culture promoted in that building. At the end, these manufactured products are being sold on the markets that are organized at the back of the plot or in public market in the village. Due to the small production area in these facilities, the sale of raw and processed agricultural products is not a wholesale. However, each of them also produces seedlings of the same plant that can be sold wholesale and, if necessary, distributed to neighboring villages and towns. The highest income comes from the sale of these seedlings. Money earned from the sale of raw, manufactured products and seedlings, restaurant and market is again invested in production, and so the whole system becomes sustainable. All the local agricultural products, which are cultivated in this region and under the described conditions, come into consideration for production in LMFS facilities. The owners themselves choose the type of product to be produced in the facility, based on the general regulation that determines the production schedule for each part of the village within the rural community. This arrangement defines the broader context of specialization, including all the types of plants that can be produced. Each of these buildings behaves as a self-sustaining, energy-efficient farming system, so no major investments are required in their maintenance. LMFS building is basically organized so that all five functions are under the same roof, arranged in 4 different sectors: Farming (Production) on Farm Field; Manufacturing (Processing) in a Farm Lab; Promotion

(Consuming) in the Farm Restaurant; Sale (Trading) on the Farm Market and Education (Learning) carried out in all the four above mentioned sectors (Fig 2).



Fig. 2 Local Monoculture Farming System functions
(Source of illustration Fig. 2: author's drawing (Stanišić J.))

3.1.1. Farming

Production of agricultural crops and their seedlings - Farming, takes place in the context of green roofs located below the greenhouse in a terraced designed facility. The building is terraced so that the roof area would be as large as possible in order to obtain maximum production space. This part of the facility is called the **Farm field**. In addition to excellent thermal insulation, the installation of extensive green roofs allows the cultivation of various seedlings and agricultural products of low growth whose processing would be conducted in the building. It is also a way of returning back what was taken from the nature - a piece of land occupied by the building itself. This reuse of land as a renewable resource from the immediate local environment for roof gardens is one of the applied sustainable principles of traditional rural Vojvodina architecture in the modern building solution of LMFS. Green roofs are organized on terraces of the buildings and are situated within greenhouses. In order to save electricity for heating and lighting, greenhouses are built with reflective surfaces. Reflective surfaces are the cheapest source of energy, and in addition to thermal radiation, they reflect light as well. For faster growth and maturation of plants, a reflective surface is attached to a glass of a greenhouse. The thermal

effect is achieved by less dissipation of heat on the north side because of reflective surfaces installed, and in addition to that, insulation is doubled in the cheapest way. Each greenhouse has its own heating and led lighting system providing optimal farming during winter months.

3.1.2. *Manufacturing*

Processing of agricultural products and their seedlings is carried out in the enclosed spaces of the building, located below the production areas of green roofs. This part of the facility, with the necessary equipment for manufacturing and packaging the certain type of product is called the **Farm Lab**.

3.1.3. *Promotion*

The promotion of manufactured products is organized in a **Farm Restaurant** that occupies a front part of the ground floor. The restaurant is intended for potential customers to become familiar with the primary and secondary processed products. This area functions as an exhibition space. It is possible to organize festivals, which will draw attention to a specific plant. These festivals would attract residents of neighboring villages and towns and so stimulate the development of tourism in rural areas of Vojvodina. Neighbors would have the opportunity to get familiar with the final products, consume them and buy on the markets.

3.1.4. *Sale*

The sale of raw and processed products is carried out in the context of the last part of the plot in Vojvodina villages, where, at a certain part of the day, **Farm Market** is organized. The stands on which the products are presented are cube-movable containers that are "pulled out" from the building. These movable containers are an integral part of the ground floor of the facility, but not a necessary part of the building because the skeletal system of the construction allows the facility to be maintained without them. Each container is a functionally independent unit for itself. The building changes its shape and appearance of the ground floor thanks to the mobile containers. Their mobility allows them to be "pulled out" of the building to the inside of the plot where they unfold and set so they become sale stands at the market (Fig. 3). In the hours when the market is closed, cubes are drawn to the ground floor of the building where they fit perfectly so they become a part of it and then the facility is "closed" toward the street which ensures its

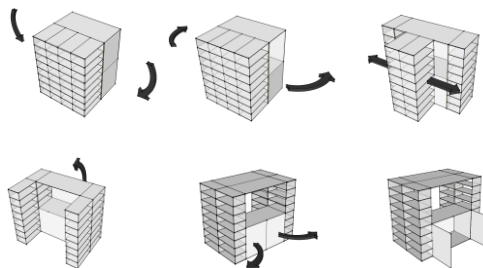


Fig. 3 Unfolding system of the cubes
(Source of illustration Fig. 3: author's drawing (Stanišić J.))

privacy. When the market is open, the part of the ground floor, which is designed for cubes, becomes an open, fluid area which allows visitors access to the market from the street. Due to a specific linear form and a large length of parcels in Vojvodina villages, containers are assembled within the last part of the plot so as to allow for the maximum use of the area to display as many products as possible.

3.1.5. Education

Education and employment of young rural population in LMFS facility takes place in all four sectors. Since the primary idea of the project is to reduce the unemployment of the young people in villages of Vojvodina and educate them about agricultural production, it is necessary for them to learn all phases of the agricultural good's life cycle so that they can later assign knowledge to their own household.

4. ARCHITECTURAL FEATURES OF THE BUILDING – EXPERIMENTAL STUDY

Architectural features of the LMFS building will be defined based on an analysis of the possibility to interpolate it within the existing structure of rural Vojvodina settlements. The analysis will be carried out in the plan and the model, based on one of the existing typologies of Vojvodina houses. As a result of these analysis, more possible variations of the new facility will be formed, that is, its typology. By integrating these different types of buildings into a wider neighborhood, the residential areas of Vojvodina villages would become multifunctional, without changing its appearance and structure. Using the benefits of traditional Vojvodina houses construction in design, new type of facility remains in accordance with the environment and ambience of this rural areas. Appearance and variations in the model of the new building will depend on these analyses and applied energy-efficient principles, both traditional Vojvodina's and modern technologies.

„The spirit of heritage is to be expressed in other ways-not going back to heritage and tradition but starting with them. As heritage is a tested experience of previous generations it should not be ignored but it should transpose the inherited and develop it to meet modern needs.“[7]

4.1. Environment and plan study

Based on analysis of one of the existing typologies of Vojvodina houses and specific sustainable principles organizing their environment, different types of the new building plan are formed.

4.1.1. Terrain configuration

Flat terrain, continental climate, which provides a lot of sunny days per year, and a relatively small altitude, are the advantages of Vojvodina's territory which contribute to the benefits for utilization of solar, geothermal and other renewable energy sources. In addition, the physical-geographic environment and geological composition of land in Vojvodina most of all influenced the choice of construction material, since the residents of this area have always used material that they had close to the hand. They were mainly using material from the immediate surrounding such as rammed earth, adobe, cane, etc.

For the needs of the roof production areas, project LMFS also uses the ground from the immediate environment, land taken from the nature by building the facility itself. This provides returning to the nature what has been taken away from it, and the land is again used (reused), as a renewable source, in the contemporary interpretation of Vojvodina landscape - roof gardens.

4.1.2. *Housing and plot organization*

Traditional villages in Vojvodina have particularly formed housing organization which represents the result of an orthogonal urban scheme from the time of Theresian space planning. The existing concept of typical housing organization with placing different content along the depth of the plot is very suitable for the use of solar energy as a renewable source. The new LMFS facility, with its structure and organization, respects the basic and essential aspects of the Vojvodina house: linear organization, shape and dimensions of the plan and placing the side facade, gable, on the street regulation line, which is one of the symbols of the traditional Vojvodina house. One of the principles of the Theresian planning determined the distance between the neighboring houses, which had to be at least 17 meters long, due to the risk of fire. This ensures uninterrupted sunshine on the south side of the plot and greater use of solar gains.

4.1.3. *Plan shape and form*

Different plan types of the LMFS facility will be formed according to the existing typology of Vojvodina houses, based on the relationship between the house and the plot (Fig. 4). The differences between these types are reflected in the possibilities of applying traditional energy efficient principles precisely because of the different relationship between the house and the plot. In order to fit the building into the environment of residential zone in Vojvodina villages, without compromising its physical structure or traditional ambient values, for each type of existing typology possible models of a new facility are being developed (Fig. 5). All types of the new LMFS building observe the basic characteristics of the Vojvodina housing organization: shapes and dimensions of plans correspond to the types of existing typology, and the organization of the Local Farm Market within the last part of the plot complies with the contents of the plot of Vojvodina houses. Dimensions of houses from the analyzed typology range from 5-6 m x 12-18 m. LMFS building is designed according to the principle of modules that can, if necessary, easily be "reproduced" without violations of its construction and function. The simple shape and design of the facility allows for its expansion or for increasing the square footage of its surfaces with an aim of getting larger production areas in case it needs to produce more plants and seedlings. Also, in case a larger production and sales areas are needed, it is possible to connect two neighboring plots, multiplying the module of the facility form (Fig. 6). Types of the existing Vojvodina house typology, based on the relationship between the house and the plot, from which different plans of the new building were formed are: Furrow house, Long house, Front house, Corner house and Turn-key house.

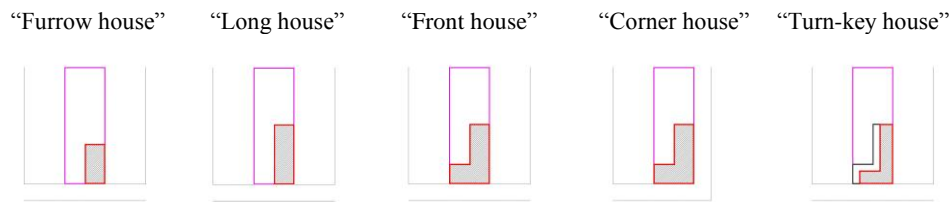


Fig. 4 Traditional Vojvodina house typology depending on the relationship between the house and the plot

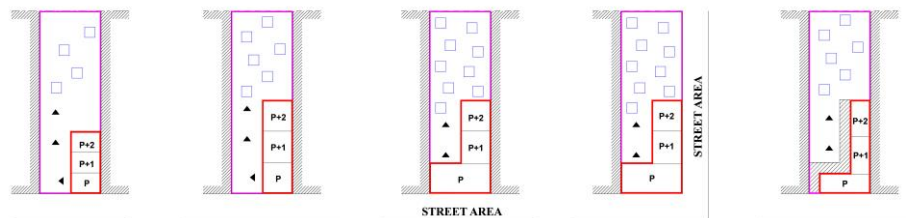


Fig. 5 LMFS typology – single plots

Legend: P=ground floor (Parterre-French); P+1=first floor; P+2=second floor

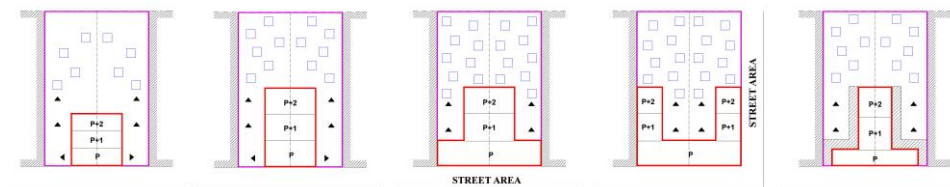


Fig. 6 LMFS typology - joined plots

Legend: P=ground floor (Parterre-French); P+1=first floor; P+2=second floor
(Source of illustrations Fig. 4,5,6: author's drawings (Stanišić J.))

4.1.4. Plot landscaping

The existing concept of housing organization in Vojvodina villages enables the formation of favorable landscaping on the plot in order to establish better bioclimatic conditions, improve the energy efficiency of the house itself and reduce heat losses during winter months. In this regard, the vegetation has a double function: it regulates the heat and light effect of the sun and the influence of dominant winds.

1) Vegetation as a temperature regulator (sun protection)

Adequate arrangement of vegetation on Vojvodina plots can greatly contribute to the regulation of temperature, that is, the thermal and light effect of sunlight. Placing deciduous trees on the south side of the plot makes a shadow, or protection from the sun during summer. In winter, when the leaves fall, these trees filter the sunlight rays and allow them to get to the building. This increases the heat gain during winter months. Also, vegetation reduces the need for artificial cooling in the summer because the absorption of sunlight lowers the ambient temperature and reflection.

2) Vegetation as wind protection

The dominant winds in Vojvodina, Kosava and Severac, have a double effect: they provide a favorable cooling effect during summer, while in winter they increase heat losses. Planting the coniferous trees on the north side of the plot provides adequate wind protection throughout the year. Deciduous trees on the south side of the plot turn the direction of dominant winds, toward the building in the summer, and from it during winter (Fig. 7).

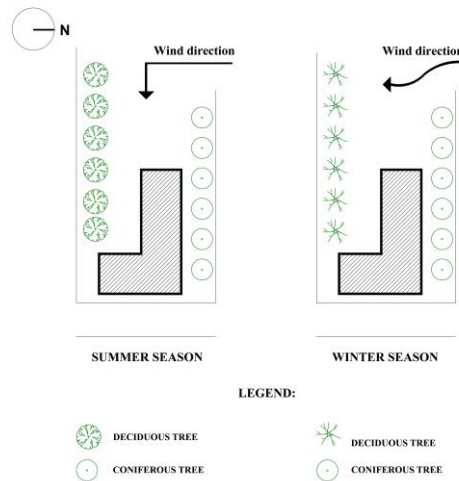


Fig. 7 Plot landscaping

(Source of illustration Fig. 7: author's drawing (Stanišić J.))

4.2. Design and model study

Different types of the LMFS building model are formed based on the analysis of the existing typology of traditional Vojvodina houses. The design and shape of these models represent the result of this analysis and applied traditional and modern energy efficient principles in construction.

4.2.1. Model design

These models are studies of contemporary architecture design which can be developed according to the location and context of Vojvodina villages by applying traditional construction principles of their houses. The LMFS facility is terraced designed for the needs of the production areas of green roofs, which is not typical for traditional Vojvodina houses. Compliance with the environment is achieved with implementation of the greenhouse whose design shapes the models in such a way that they receive a simple archetypal form of the Vojvodina house. When observing the LMFS model from the pedestrian perspective, the feeling of existence of the terraces is lost and the building fully gets the appearance and form of the Vojvodina house (Fig. 13). The modular structure of the facility allows expanding its area to neighboring plots, in case of need for larger production areas. Construction of the greenhouse covers only the front part of the plot during the summer months. In winter, it can be extended to the back of the plot, covering the Local Farm Market. For each of five types of the existing

typology of Vojvodina houses, four different types of LMFS structures have been formed, depending on their size and construction of the greenhouse. So there are four models for each type of building: on single or multiplied-joined plots and with greenhouse on the front and the back of the plot (Fig. 8, 9 10, 11, 12). Since the LMFS facility has a larger number of floors than the typical house in Vojvodina, the storey height is reduced so the continuity and skyline of these villages would not be disturbed. By applying the same arrangement and windows shape as in the Vojvodina house, natural ventilation in the building and compliance with the existing environment is achieved. The application of traditional, gabled roof of Vojvodina houses on the LMFS facilities enables the installation of solar collectors that supply the entire facility with the necessary energy from the sun as a renewable source. Type of solar collectors, used in the building, is made in the form and color of traditional tile roof cover, so that the new LMFS facility remains in compliance with the environment, in this segment too.

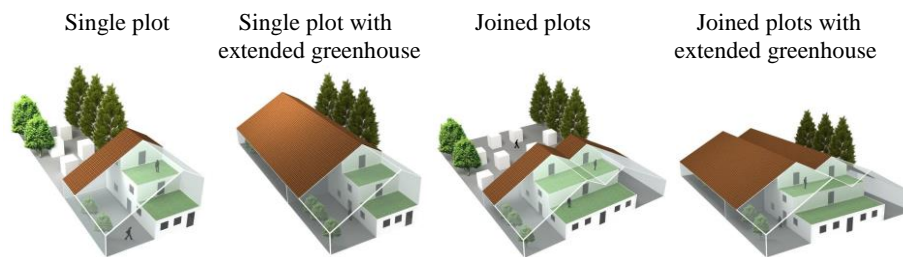


Fig. 8 LMFS model typology – Traditional “Furrow house” variations



Fig. 9 LMFS model typology – Traditional “Long house” variations



Fig. 10 LMFS model typology – Traditional “Front house” variations



Fig. 11 LMFS model typology – Traditional “Corner house” variations



Fig. 12 LMFS model typology – Traditional “Turn-key house” variations



Fig. 13 LMFS model elevations

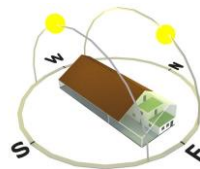


Fig. 14 Model orientation

(Source of illustrations Fig. 8,9,10,11,12,13,14: author's drawings (Stanišić J.))

4.2.2. Orientation

The roof, solar panels in the form of tiles and glass surfaces of greenhouses are mostly open and oriented towards the south thanks to the favorable position and orientation of the plots of Vojvodina houses (Fig. 14). This results in good day lighting and solar radiation gain throughout the whole year. In case of extension greenhouse construction on the last part of plot, the Farm Market, roof area for installation of solar collectors is increasing. Regulation of temperature within the building and protection from the wind, sun and other exterior factors is achieved with adequate orientation of traditional Vojvodina landscape design as previously explained in the paper.

4.3. Functional organization study

LMFS building is designed and functionally organized in such a way that it fully meets the needs of production, processing, promotion and sale of agricultural goods. The ground floor of the building is divided into three sectors. The processing of products is carried out in the Farm Lab in the last part of the ground floor, while the part of the ground floor which is oriented toward the street is reserved for the Farm Restaurant-

exhibition space and mobile containers that serve as stands for the sale of products on a Farm Market. At the time when the market is open, cubes are taken out of the facility, unfolded and placed on the inner part of the plot (Fig. 15). The indoor part of the first floor is a space for the processing of products, Farm Lab, while the open terrace - green roof is a Farm Field for the production of a specific plant and its seedlings (Fig. 16). The last (second) floor of the facility is also divided into two parts: the Farm Lab and terrace garden for production, Farm Field (Fig. 17). Each individual model of the LMFS building typology has the same functional disposition regardless of its size, shape and model type.



Fig. 15 LMFS model example – ground floor function



Fig. 16 First floor function

Fig. 17 Second floor function

(Source of illustrations Fig. 15, 16, 17: author's drawings (Stanišić J.))

5. APPLIED PRINCIPLES

Design, shape and appearance of the LMFS facilities depend a lot on applied energy efficient principles, both traditional Vojvodina and modern technologies. Thanks to this reconciliation between traditional and modern, the building represents a contemporary solution as a reinterpretation of the traditional rural architecture and principles. Reviewed traditional, urban and architectural, energy efficient principles of Vojvodina houses construction, which are implemented in the design of an LMFS building are: 1) Reuse of land; 2) Terrain configuration; 3) Housing organization; 4) Plot and plan shape and dimensions; 5) Landscape design and vegetation; 6) Orientation; 7) Compact archetypal model shape; 8) Fenestration; 9) Traditional gabled roof shape; 10) Traditional construction materials; 11) Water from local wells. Some of the modern sustainable technologies applied, that are convenient for the use in the conditions of Vojvodina villages environment are: 1) Green roofs; 2) Greenhouses with reflective surfaces; 3) Solar panels in a form of traditional tiles; 4) Geothermal energy production; 5) Biomass energy and CO₂ production; 6) Rainwater and Wastewater collection. All the applied energy efficient principles and the system of their functioning are shown on the example of one type of LMFS facility (Fig. 18).

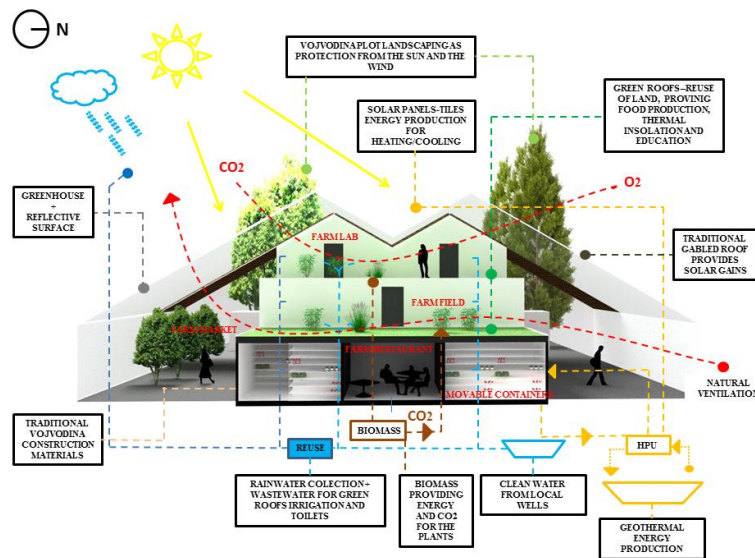


Fig. 18 Presentation of applied traditional and modern energy efficient principles (Source of illustration Fig. 18: author's drawing (Stanišić J.))

6. CONCLUSIONS

Abandonment of rural areas represents a current problem for the entire world. People are increasingly turning to cities under the influence of modern urban processes. The LMFS study project is an opportunity for preventing further departure of people from rural areas and an attempt to improve the economic and social situation, not only in villages of Vojvodina, but also in the entire country. Construction of several such facilities in one village in Vojvodina creates new employment opportunities for the rural population, and changes the rural tradition that in villages only land serves for work and not buildings. It gives an opportunity to the rural population to shift from agricultural land to man-made facilities and find employment in them. The village is "urbanized" in a certain way and becomes "closer" to the city lifestyle. The LMFS offers reconciliation between the traditional and the modern and establishes a rural-urban synergy. Cherishing rural tradition and re-using the energy efficient principles of traditional Vojvodina construction in the contemporary architecture of the LMFS facility, we preserve traditional local rural communities from decline in a new form that is in accordance with the conditions of modern society. Taking into account conditions of local environment during construction of these facilities and without compromising traditional architecture and urbanity of rural areas, the identity of Vojvodina can be preserved.

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PRIMENA ENERGETSKI EFIKASNIH PRINCIPA TRADICIONALNE VOJVODANSKE KUĆE NA SAVREMENOM OBJEKTU LOKALNOG MONOKULTURNOG POLJOPRIVREDNOG SISTEMA

Istraživanje pristupa aktuelnom problemu depopulacije i devastacije ruralnih područja u Vojvodini, koja polako nestaju, jer se sve više mladih ljudi okreće gradovima i urbanom načinu života, u potrazi za komfornijim radnim uslovima koji nisu u vezi sa poljoprivrednim aktivnostima. Ova sela, zajedno sa svojom jedinstvenom ruralnom arhitekturom, predstavljaju identitet područja, čiji bi nestanak doveo do gubitka identiteta i značaja Vojvodine. Sa druge strane, rad razmatra i jedan od problema današnje istraživačke prakse koji se odnosi na stalne pokušaje i potrebe interpolacije poljoprivredne proizvodnje u ionako već preizgrađena i zagađena gradska područja, čime se sela još više zanemaruju. Iz navedenih razloga se javlja potreba za uspostavljanjem jedinstvene strategije koja bi omogućila oživljavanje vrednih seoskih zajednica u Vojvodini, i učinila ove prostore boljim i naprednijim mestima za život, zadržavanjem poljoprivrede unutar ruralnih granica, kao i očuvanjem autentičnosti i tradicije vojvođanskog regiona.

Rad prezentuje projekat "Lokalni Monokulturni Poljoprivredni Sistem" kao koncept vizionarskog modela za novi tip objekta u selima Vojvodine čija bi izgradnja mogla da spreči dalji odlazak ljudi sa ovih prostora, pružajući im mogućnosti obrazovanja i zapošljavanja unutar objekata umesto rada na zemlji, budući da je to jedan od razloga zašto odlaze. Oslanjajući se na energetske efikasne principe tradicionalne vojvođanske kuće u izgradnji, ali primenjujući i neke moderne, održive tehnologije, ovaj futuristički model poljoprivrednog sistema omogućio bi povezivanje tradicionalnog i modernog u ruralnim sredinama Vojvodine. Projekat povezuje poljoprivredu, energetska efikasnost, nasleđe i arhitekturu kako bi se oporavili i ponovo koristili lokalni resursi vojvođanskih sela kao kulturni pristup u savremenim istraživanjima za održiva moderna rešenja.

Ključne reči: energetska efikasnost, poljoprivreda, ruralna područja, Vojvodina, nasleđe, savremena arhitektura