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ECONOMIC AND ECOLOGICAL CONDITIONS CONCERNING SOME EXPERIENCES OF UPPER MISSISSIPPI RIVER VALLEY IN US

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Abstract:
Study analyses correlations among main economic and ecological variables of the United States of America for researched period of 2010-2021. Correlations of different variables connects with conditions of Upper Mississippi River Valley. Study within correlations of economic and ecological conditions focuses on agricultural gross value added produced by irrigated agriculture, growing rate of GDP with annual growth and per capita, gross fixed capital formation in share of GDP and its annual growing rate, value added of total manufacturing in share of GDP with annual growing rate. Study emphasizes CO2 emissions in economic sectors, as on-farm energy use, agrifood systems waste disposal, food processing, food household consumption, energy. Study uses Statistical Program for Social Sciences, which provides possibilities to analyse correlations among different economic and ecological conditions of US concerning issues of Mississippi River. In 2021 annual GDP growth, value-added total manufacturing and gross fixed capital formation increased by more than 5%, and CO2 emissions less decreased by 5% in food processing and by 12% in energy CO2 emissions. Emissions CO2 of food household consumption decreased by 19% and emissions CO2 of on-farm energy use decreased 16% comparable to last years. More increase of economic growth connects with less CO2 emissions.

Keywords: *Agricultural value added, Correlations, Food consumption, Gas emissions, Household, Variables*

1. INTRODUCTION

This study would like to analyse correlations among main economic and ecological variables of the United States of America for the period of 2010-2021. The correlations of different variables have wide-side connections with conditions of the Upper Mississippi River Valley (UMRV) at the same time. The US plays significant economic role in the global economy; therefore, the US has important influences on the processes and development trend of the world market. The whole watershed of Mississippi River Valley – together Upper and Lower River Valleys – has about 3.2 million km2, which means that this is one third of US area. The Mississippi river collects water from this wide side area and brings this water to the Mexico gulf. Naturally these natural conditions emerge some important questions that how the large amount of water and soil as sediment can be kept back in US. This case study focuses on the main economic-ecological correlations accompanying with some water issues of the Upper Mississippi River Valley, because all of this river issue can be so bigger one within this case-study.
The study within correlations of economic and ecological conditions focuses on agricultural gross value added (GVA) produced by irrigated agriculture, growing rate of GDP with annual growth and per capita, gross fixed capital formation (GFCF) in share of GDP and its annual growing rate, value added of total manufacturing in share of GDP with annual growing rate. Additionally, to the above-mentioned objectives, the study emphasizes the CO2 emissions in some main economic sectors, as on-farm energy use with emissions CO2 totals, the agrifood systems waste disposal with emissions CO2 totals, food processing with emissions CO2 totals, food household consumption with emissions CO2 totals and energy, emissions CO2 totals during period of 20210 and 2021 (Table 1; Table 2; Table 3; FAO-AQUASTAT 2023). These correlations among mentioned economic and ecological variables can make

some influences on some examples for management in field of Upper Mississippi River Valley. Importance of this river as the sustainable water use of Mississippi river is to support agricultural production, industrial, manufacture and energy sectors by advanced modern innovative technology based on productive, efficient and effective methods (efficiently, effectively, productivity). There are some difficulties of the river as large water reservoirs behind dams makes difficulties for seasonal pattern of river-water discharge and interrupts sediment going into Mississippi river (Floodplain Management 2010). Some main reports concerning the Upper Mississippi River Valley can provide important experiences for water management of this river (AWI Steering Committee 2015). Also, some experts declared that by the start of the 21st century it was clear that regulation alone was not enough, and people began taking additional steps to restore the lost functioning of natural ecosystems (Allan – Palmer 2006). This argument is satisfactory for the main goals for Mississippi river as providing reliable flood control and risk reduction.

The wide-side analyses of this study for the economic-ecological correlations are based on the statistical data coming from FAO AQUASTAT Dissemination System, FAOSTAT 2023 Macro Indicators and FAOSTAT 2023 Emissions Total concerning the original national scientific and statistical sources of the US. Some experts emphasized importance of green climate policy to mitigate gas emissions and ensure clean policy for natural environment, which are strongly connecting with sustainability of Mississippi river valley basin.

The Los Angeles fires alone will cost insurers $30 billion (Zahn 2025). Over the last 45 years, climate-related disasters have cost the U.S. more than $2.9 trillion (Office of Management and Budget 2005).

In addition, the U.S. Climate Alliance, representing over half the national economy, is committed to cutting emissions by at least 50% by 2030 (U.S. Climate Alliance 2025). Meanwhile, at least 3,000 U.S. companies that conduct business globally are expected to have to comply with climate reporting requirements under international frameworks like the EU's Corporate Sustainability Reporting Directive (CSRD) (Abramson 2024). Climate finance also remains compelling on the opportunities side. *Clean energy investment in the U.S. hit a record $248 billion in 2023—triple the 2018* (Climate Central 2024). Political shifts won't change the fact that climate risks are real and accelerating. Despite regulatory rollbacks, wildfires, floods, and extreme weather continue to cause billions in financial losses, making it be essential for investors to focus on long-term risks and opportunities (Lorenzo 2025). Naturally the environmental conservation policy also focuses on decreasing flood risk of Mississippi river and remaining the river habitat in the ecosystem.

The analyse focuses on *some main hypotheses*, which are as follows:

The analyse wants to provide proof that GDPpCap2 has any correlations with GrowGDP3 and GFCFAnn5, VaAdMAnn7.

The study provides proof the any correlations of GrowGDP3 with GFCFAnn5 and VaAdMAnn7.

The study provides proof that any correlations of GFCFinGDP4 with VaAdManu6, HousEmis11 and EnEmisTo12.

Also, it should be important to get proof that VaAdManu6 has such correlations with HousEmis11 and EnEmisTo12.

The study provides proof that VaAdMAnn7 has important correlations with FoodPrCO10.

The study provides proof that HousEmis11 has any correlations with EnEmisTo12.

The AGVA1 variable has any correlations with GFCFinGDP4, FarmEnCO8, FoodPrCO10 and HousEmis11.

Naturally the correlations can be among other economic-ecological variables in the researched period in case of the US, which can also make somehow any influences on each-others, but these correlations among variables can probably be less important than the above-mentioned variables.

Also, there some important economic and ecological data, which have not considerably been changing in the US for period of 2010-2021, but these provide important actual conditions of US. These data, which concern fields of irrigation by surface water, for irrigation by groundwater, cultivated area equipped for irrigation, area equipped for irrigation total in hectare, total country area cultivated,

agriculture valued added in GDP, irrigated cultivated area (arable land + permanent crops) and human development index.
The SPSS statistical system (Field 2020; Horváth-Mitev 2023) can calculate such any data, which are really changing, as variables, otherwise the statistical system cannot include non-changing data.
The study focuses on the analysing some connects among economic -ecological variables and *several features of Upper Mississippi River Valley in the latest decade*. These connects can emphasize the successful enforces of local and federal American authorities to strengthen the *sustainability of the Mississippi River Valley* for interests of extending flood risk control, clean water supply, navigation for transport, sedimentation and restore ecosystems within the Mississippi River Watershed to support natural habitats.
The following chapters overview the research methods of the case study based on the statistical analyse and then provide summaries of tables and figures used in the research.

2. RESULTS AND DICUSSION

In the United States there were considerable changes in the fields of CO2 gas emissions responsible for the global warming based on the economic growth. Each given year is characterized by economic variables as its features. The *Figure 1* shows different years of the researched period with their economic features based on the *correlations between*
.- at principal line "X" *Component 1* including share of the gross fixed capital formation in GDP (*GFCFinGDP4*), share of value-added total manufacturing in GDP (*VaAdManu6*), on-farm energy use emissions CO2 totals (*FarmEnCO8),* food processing emissions CO2 totals (*FoodPrCO10*), emissions CO2 total of food household consumption (*HousEmis11)* and energy emissions CO2 totals (*EnEmisTo12*) and
.- at principal line "Y" *Component 2* including annual growth of GDP per capita (*GDPpCap2*), annual growing rate of GDP (*GrowGDP3*), annual growth of gross fixed capital formation (*GFCFAnn5*) and annual growth of value-added total manufacturing (*VaAdMAnn7*) economic variables.
The *first quarter* up-right side as positive session of the coordinate system shows that the CO2 gas emissions little increased in 2010 and then little decreased in 2015 comparably to other further years between 2019-2021 (also Tables 2-3). But in the *fourth quarter*, down-left side as negative session of the coordinate system in 2019 and 2020 the CO2 gas emissions more considerably decreased, while the economic growth little increased in 2019, but considerably decreased in 2020 because of corona virus extending globally. The annual growth of value-added total manufacturing increased by 5.7% in 2010, and little increased only by 0.5% in 2019, while this sharply decreased by 4.3% in 2020. This means that the CO2 gas emissions considerably decreased in 2020 for example by 20% in fields of emissions CO2 total of food household consumption against its decrease by 13% in 2015 and by 19% in 2019. While energy emissions CO2 totals against considerably decreased by 17% in 2020 comparably to its decrease by 5% in 2015 and by 7% in 2019. This shows that when in 2020 the economic growth decreased in fields of GDP growth per capita, annual GDP growth, annual growth of value-added total manufacturing and annual growth of gross fixed capital formation considerable decreased, while CO2 gas emissions remaining more considerably decreased, but only in field of food processing CO2 emissions comparably little decreased by 18% in 2020 to its result by 22% in 2019. In 2020 there was a health crisis as corona virus in global economy, which resulted some economic decreases either in US or in most of countries of the world.
In the *second quarter* up-left side of the coordinate system in 2021, when the annual GDP growth, GDP growth per capita, annual growth of value-added total manufacturing and annual growth of gross fixed capital formation increased by more than 5% in all of their cases, CO2 gas emissions only less decreased by 5% in fields of food processing CO2 gas emissions and by 12% in energy CO2 gas emissions. While the emissions CO2 total of food household consumption could decrease by 19%. Emissions CO2 total of on-farm energy use also considerably decreased 16% comparable to last years by 9% in 2020 and 8% in 2015. Based on economic results it can be mentioned that more increase of economic growth connects

with less CO_2 emissions, which can be resulted by more environmental-friendly technologies used in US during the period of 2021-2021.
These Figure 1 very clearly show the contradictive correlations between the increasing economic growth and decreasing CO_2 gas emissions for the little more than one decade. In case of the US this contradictive trend is a favourable economic condition, but this one alone cannot solve the global warming, while the US growth can be seen as good initiative steps for the future economic growth. These overviews emphasize importance of increasing attention for decreasing gas emission.
Reply for hypotheses. Based on researches concerning main results and data base of the *Table 4* in the US during researched period of 2010—2021, it is proofed that annual growth of GDP per capita (***GDPpCap2***) has *very strong* correlations by 0.997 (99.7%) with annual growing rate of GDP (*GrowGDP3*) and by 0.950 (95.0%) with annual growth of gross fixed capital formation (*GFCFAnn5*) and by 0.858 (85.8%) with annual growth of value-added total manufacturing (*VaAdMAnn7*).
Results of the research provide proof that annual growing rate of GDP (***GrowGDP3***) has very strong correlations by 0.954 (95.4%) with annual growth of gross fixed capital formation (*GFCFAnn5*) and by 0.878 (87.8%) with annual growth of value-added total manufacturing (*VaAdMAnn7*).
Results of the study strengthen that share of the gross fixed capital formation in GDP (***GFCFinGDP4***) has *negative very strong* correlations by (minus) 0.905 (-90.5%) with of share of value-added total manufacturing in GDP (*VaAdManu6*), by (minus) 0.982 (-98.2%) with emissions CO_2 total of food household consumption (*HousEmis11)* and by (minus) 0.830 (-83.0%) with energy emissions CO_2 totals (*EnEmisTo12*).
In the US there are special contradictive correlations between two variables namely the share of the gross fixed capital formation in GDP (*GFCFinGDP4*) and share of value-added total manufacturing in GDP (*VaAdManu6*). In spite that the share of the gross fixed capital formation in GDP has sharply increased for this period and the share of value-added total manufacturing in GDP has decreased for the same time. This shows that the fixed capital formation extended in other sectors out of the manufacturing, for example in service sectors and infrastructure or logistic network.
Also, share of the gross fixed capital formation in GDP (*GFCFinGDP4*) considerably increased and its share in GDP originally remained as a large one, while the emissions CO_2 totals could considerably decrease in fields of food household consumption, energy sector, on-farm energy use and food processing. This signs, that the US implemented considerable forces to decrease emissions CO_2 totals, while the fixed capital formations were realised in order to increase prosperity of economic development (Table 2, Table 4). The considerable decrease of emissions CO_2 totals was considerable, but this one did not decrease level of CO_2 gas emissions determined by the Paris Agreement in 2015. Therefore, also, these data strengthen reasons, why the US refused to accept the demands of Paris Agreement in 2015.
Also, it should be important that share of value-added total manufacturing in GDP (***VaAdManu6***) has very strong correlations by 0.959 (95.9%) with emissions CO_2 total of food household consumption (*HousEmis11)* and by 0.905 (90.5%) with energy emissions CO_2 totals (*EnEmisTo12*).
For the environmental conservation of the US the emissions CO_2 totals *agri-food systems* waste disposal has extended by little not considerable rate for the researched period, therefore, this variable cold not enough considerable impact on the other economic-ecological variables of this study. This can be proofed from the Table 2 and Table 4 (FAO AQUASTAT 2023) but this does not mean that this variable cannot be important, only in this researched period is not considerable. *FAO defines agri-food systems* as all the interconnected activities and actors involved in getting food from field to fork. This broad definition encompasses everything from agricultural production and processing to distribution, consumption, and waste management. It also highlights the critical role of economic, social, and environmental factors in shaping how food reaches our plates (FAO 2025).
Also, there some important economic other data base out of the SPSS as statistical analyses, which show that *cultivated area* as arable land with permanent crops is 160 million hectares of which 16.7% is irrigated. This share of *irrigated areas* internationally comparably is considerable against 10-12% globally. 65% of area equipped for irrigation by *groundwater* is realised, which can lead to less water

transpiration from reserved water stock based on the climate change and longer drouth period. This is better more favourable condition of water use than use of *surface water* as remaining 35%. Because of the *agricultural value added* is at highly level in value of production, but its share of GDP has little part, namely between 0.89%- 0.96%, because other sectors are mostly heavy industries, mining sectors and service sectors are considerable. Additionally, to these data the *human development index* (HDI) is at very highly level as 0.9% closed to 1.0 as maximum level. This data shows how much the educated level, purchase power parity and healthy level of the population of US during the researched period (FAO AQUASTAT 2023).

Upper Mississippi River Valley for the service of environmental conservation

According to the above mentioned economic and ecological features of US the American economic and ecological strategy would like to manage successfully the water issue concerning the surface water supply from Upper Mississippi River Valley. The all-Mississippi River Valley has watershed equally to mostly one-third of the continent area of US between two Atlantic and Pacific oceans, from which area the Mississippi river collects water. There some main goals for the Mississippi River Watershed included in *support and enhance healthy and productive ecosystems* within the Mississippi River Watershed to support natural habitats and the fish and wildlife resources. *Provide reliable flood control and risk reduction* through well managed and maintained infrastructure, including appropriate floodplain connections for water conveyance and ecosystem benefits, and management of surface. *Serve as the nation's most valuable river transportation corridor* to ensure a competitive advantage for national goods in global markets. *Maintain supply of abundant clean water* ensuring the quality and quantity of water in the Mississippi River Basin. *Support local, state and national economies* to sustain a water use system to efficiently and effectively support agricultural, industrial and energy productivity. Provide world-class recreation opportunities ensure the quality of life for people and recreation-based economies by maintaining and enhancing riverine, lake and wetland (AWI Steering Committee 2015).

About the *Upper Mississippi River Basin Association* – (UMRBA) is a five-state interstate organization formed by the Governors of Illinois, Iowa, Minnesota, Missouri, and Wisconsin to coordinate the states' river-related programs and policies and work with federal agencies that have river responsibilities. The UMRBA is structured as a 501(c) non-profit association, with the Board of Directors composed of all duly Governor-appointed representatives and alternatives. Through UMRBA, the Governors' joint interstate collaborative, the above-mentioned states are bringing together those who live and work in the floodplain to improve disaster preparedness, economic growth and resilience, and ecological health. The Governors declared purposes concerning this Upper River Regions, as 1) increase the economic, ecological, and social resilience of the Upper Mississippi River to major flood events, prolonged drought, and excessive sediment; 2) Foster dynamic, balanced, objective, and adaptive approaches to flood, drought, and sediment management in a multi-purpose management context. In detailed the Governors describe objectives in detailed as 1) develop an integrated, comprehensive, and systems-based approach to minimize the threat to health and safety resulting from flooding by using structural and non-structural floodplain management measures; 2) Develop new, or renew existing, comprehensive long-term channel management strategies that are sustainable, cost-effective, and ecologically sensitive; 3) develop mitigation strategies for multi-year drought events that would increase the resilience of communities and economies adjacent to, or dependent on, the river; 4) seek opportunities to support environmental sustainability, restoration, and water quality goals for the Upper Mississippi and Illinois Rivers; 5) accelerate efforts in the watershed that reduce the volume and rate of runoff to the Mississippi River. (Ecosystems of Upper Mississippi River Basin Association 2015).

Main results of the activities of Upper Mississippi River Basin by the middle of 2010s are as economic sectors in the UMR corridor generate more than $345 billion annually, supporting over 1 million jobs.

Manufacturing, tourism and agriculture account for over 90 percent of the total UMR corridor revenue within the 133-county corridor, supporting 92 percent of total employment. Tourism and outdoor recreation support more than 420,000 jobs. The detailed results are based on the

REVENUE: Manufacturing 81.70%, Agriculture 7.21%, Tourism 5.96%, Energy Production 2.3%, Mineral Resources 1.38%, Outdoor Recreation 1.16%, Commercial Navigation 0.19%, Water Supply 0.09% and Natural Resources Commercial Harvest 0.006%.
JOBS: Manufacturing 49.14%, Agriculture 11.91%, Tourism 31.29%, Energy Production 0.71%, Mineral Resources 1.15%, Outdoor Recreation 5.56%, Commercial Navigation 0.08%, Water Supply 0.11% and Natural Resources Commercial Harvest 0.04%. *Economic sectors in the UMR corridor generate more than $345 billion annually*, supporting over 1 million jobs. *Manufacturing, tourism and agriculture* account for over 90 percent of the total UMR corridor revenue within the 133-county corridor, supporting 92 percent of total employment. Tourism and outdoor recreation support more than 420,000 jobs. (Ecosystems of Upper Mississippi River Basin Association 2015; Mississippi River Watershed Report Card 2020).
The above-mentioned data shows that the *manufacturing sectors were more profitable* because the 81.70% of all revenues were given by this sector, while its share of all jobs was only half of all jobs in Upper Mississippi River Basen. Also, these sectors included from food processing to petroleum and chemical manufacturing, from transporting raw materials to processing facilities, supplying water for processing, washing, and cooling, and safely at cost-effective level. The second efficient sector was the agriculture by 7.21% after manufacturing in fields of revenues, but its share of jobs was higher by 11.91%, which shows less profitable sector than manufactures. This can be resulted by somehow *little farming measures*, therefore, less profitable and income possibility. The farmers have financial difficulties to obtain fertilizers and water-supply. Also, production of farmers is mostly pressed by drought weather and water-flood crisis of Mississippi river and extending diseases in animal stocks. Sometimes the large scale small, retailed networks can press purchasing prices against income-interests of farmers. The other important sector is tourism, which also needs more supports from local authorities to keep level of their survival income accompanying supports for farmers.

Conclusions and Recommendations

The main results of research focus on the increasing importance of the environmental conservation, because CO2 emissions less decreasing is not enough to avoid more natural damages resulted by human activity and social economic conditions. Based on economic results it can be mentioned that more increase of economic growth connects with less CO2 emissions, which can be resulted by more environmental-friendly technologies used in US during the period of 2021-2021. Also, when the economic developing trend declined in 2020 because of corona virus extending as health crisis, the CO2 gas emissions considerably decreased based on the new innovative green technologies used. Naturally the economic decline also can contribute to less CO2 emissions.
The economic growth naturally is accompanying with increasing trends in fields of growth of value-added total manufacturing, annual growth of gross fixed capital formation and increasing use of natural resources as groundwater and surface water coming from the Mississippi River Valley Basen. This last one also demands an adequate water management and minimizes the threat to health and safety resulting from flooding.
Also, it is important to realise and adequate harmonizations between economic activities by profit maximize and *support and enhance healthy and productive ecosystems* within the Mississippi River Watershed. Additionally, to the international cooperation the national cooperation should develop even at level of common force of different American states.
For the future economic development trends, it is important to increase the innovative investment for increasing benefit for the society and natural background as base of our survival life

3. FIGURES, TABLES AND EQUATIONS

This chapter provides main tables and figures, which demonstrate changing trends of economic and ecological variables in researched period in US.

Table 1. Abbreviation of economic variables in case of United States

Economic variables	Means of economic variables	Years	Source
AGVA1	in % of agricultural GVA produced by irrigated agriculture	2010-2021	FAO-AQUASTAT 2023 Dissemination System
GDPpCap2	GDP per capita in US dollar in %, Annual growth US$ per capita, 2015 prices	2010-2021	Macro Indicators FAOSTAT, 2023
GrowGDP3	Growing rate of GDP in %, Annual growth US$, 2015 prices	2010-2021	Macro Indicators FAOSTAT, 2023
GFCFinGDP4	Gross Fixed Capital Formation, Share of GDP US$, 2015 prices in %	2010-2021	Macro Indicators FAOSTAT, 2023
GFCFAnn5	Gross Fixed Capital Formation, Annual growth US$, 2015 prices in %,	2010-2021	Macro Indicators FAOSTAT, 2023
VaAdManu6	Value Added (Total Manufacturing), Share of GDP US$, 2015 prices	2010-2021	Macro Indicators FAOSTAT, 2023
VaAdMAnn7	Value Added (Total Manufacturing), Annual growth US$, 2015 prices	2010-2021	Macro Indicators FAOSTAT, 2023
FarmEnCO8	On-farm energy use, Emissions totals, Emissions CO2, in %, 2010 = 100	2010-2021	Emissions Total FAOSTAT, 2023
AgrFooCO9	Agrifood Systems Waste Disposal, Emissions totals, Emissions CO2, in %, 2010 = 100	2010-2021	Emissions Total FAOSTAT, 2023
FoodPrCO10	Food Processing, Emissions totals, Emissions CO2, in %, 2010 = 100	2010-2021	Emissions Total FAOSTAT, 2023
HousEmis11	Food Household Consumption, Emissions totals, Emissions CO2, in %, 2010 = 100	2010-2021	Emissions Total FAOSTAT, 2023
EnEmisTo12	Energy, Emissions totals, Emissions CO2, in %, 2010 = 100	2010-2021	Emissions Total FAOSTAT, 2023

Table 2: Main several ecological and economic data of the United States of America based on the CO2 gas emissions in percent between 2010-2021

Economic variables	2010	2015	2019	2020	2021
X line					
GFCFinGDP4	14	20.6	21.18	22	21.9
VaAdManu6	12.3	11.7	11	10.8	10.8
FarmEnCO8	0.1	-8	-4	-9	-16
FoodPrCO10	0.1	-13	-22	-18	-5
HousEmis11	0.1	-13	-19	-20	-19
EnEmisTo12	0.1	-5	-7	-17	-12
Y line					
GDPpCap2	1.8	2.1	1.8	-2.7	5.5
GrowGDP3	2.7	2.9	2.5	-2.2	5.8
GFCFAnn5	2.2	4.4	2.9	-1	5.4
VaAdMAnn7	5.7	1.3	0.5	-4.3	5.7
AGVA1	20.85	20.59	20.70	20.70	20.70
AgrFooCO9	0.1	0.6	1.2	1.0	1.4

Source: FAO AQUASTAT Dissemination System, FAOSTAT, 2023 Macro Indicators, FAOSTAT, 2023 Emissions Total

Table 3: Gas emissions in different economic sectors in USA in 2020-2021

Title of sectors	Year	Unit	CO2 emissions	Decrease*
On-farm energy use	2021	kt	60814.3	-16
Agrifood Systems Waste Disposal	2021	kt	1951.6	1.4
Food Processing	2021	kt	98918.9	-5
Food Household Consumption	2021	kt	87792.3	-19
Energy	2021	kt	4744624.3	-12

Source: FAOSTAT, 2023 Emissions Total
. * = CO2 emission has decreased for period of 2010-2021 in US in percent, 2010= 100
. kt = Unit

Table 4: Correlation Matrix[a]

		AGVA1	GDPpCap2	GrowGDP3	GFCFinGDP4	GFCFAnn5	VaAdManu6	VaAdMAnn7	FarmEnCO8	AgrFooCO9	FoodPrCO10	HousEmis11	EnEmisTo12
Correlation	**AGVA1**	1.000	-.027	-.007	**-.773**	-.292	.430	.415	**.565**	.386	**.585**	**.654**	.402
	GDPpCap2		1.000	**.997**	-.046	**.950**	.069	**.858**	-.336	.399	.483	.085	.333
	GrowGDP3			1.000	-.107	**.954**	.142	**.878**	-.266	.349	**.500**	.149	.407
	GFCFinGDP4				1.000	.061	**-.905**	**-.535**	**-.780**	.192	**-.703**	**-.982**	**-.830**
	GFCFAnn5					1.000	.094	**.733**	-.354	.145	.332	.022	.346
	VaAdManu6						1.000	.471	**.733**	**-.541**	**.605**	**.959**	**.905**
	VaAdMAnn7							1.000	.046	.304	**.818**	**.554**	**.626**
	FarmEnCO8								1.000	-.342	.104	**.723**	**.729**
	AgrFooCO9									1.000	.097	-.324	-.320
	FoodPrCO10										1.000	**.738**	**.504**
	HousEmis11											1.000	**.855**
	EnEmisTo12												1.000

a. This matrix is not positive definite.

Source: SPSS analyse based on data base from FAO AQUASTAT Dissemination System, FAOSTAT 2023 Macro Indicators, FAOSTAT 2023 Emissions Total

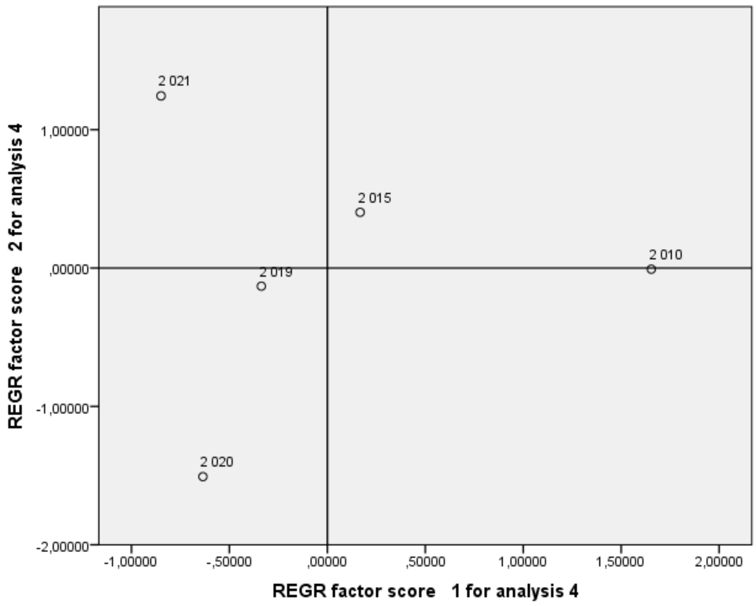

Figure 1: Correlations between Component-1 including HousEmis11, GFCFinGDP4, VaAdManu6, EnEmisTo12, FarmEnCO8, FoodPrCO10 economic variables at principal line "X" and Component-2 including GDPpCap2, GrowGDP3, GFCFAnn5, VaAdMAnn7 economic variables at principal line "Y"
Source: SPSS analyse based on data base from FAO AQUASTAT Dissemination System, FAOSTAT 2023 Macro Indicators and FAOSTAT 2023 Emissions Total

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