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WATER MANAGEMENT ISSUES IN SPAIN AND PORTUGAL AT BEGINNING OF 2020S

Sándor J. Zsarnóczai

Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering
Institute of Environmental Engineering, Doberdó u. 6, H-1034 Budapest, Hungary
e-mail: zsarnoczai@yahoo.co.uk

Abstract*: In the EU-28 productivity could have decreased somehow, because price indices of means of agricultural production, as input increased by 9,7% more than increase of price indices of agricultural products,as output in field of cereals including seeds, which increased only by 6,8% for period of 2010-2017. But agricultural income factor income per annual working unit has considerably increased by 27,2% for period of 2010-2020, mostly approximately closed to same period. This means that factor income increased more than thiscould be explained by low level of increase according to increasing rate of price indices of output in the EU-28. The agricultural income, factor income per AWU is valid for all of agricultural production also beyond cereal and seed production.* ***Motivation/Background****: Productivity of agricultural industry is basic issue to ensure sustainability of agriculture, which is accompanying with irrigation innovation. Analyse the irrigation prosperityfor the increasing output.* ***Method****: Compare price input and price out is based on statistical analysis.* ***Conclusions****: This increase of the profitability has only partly been resulted by 10% decrease of number of the agricultural total labour force, as input for this time. Because decreasing trend of the agricultural total labour force input was considerable, but subsidies for agricultural production including the consumption of fixedcapital was also significant.*

Keywords: *Annual working unit, Factor income, Input, Irrigation, Output, Productivity*

INTRODUCTION

In the EU-28 productivity could have decreased somehow, because price indices of means of agricultural production, as input increased by 9,7% more than increase of price indices of agricultural products, as output in field of cereals including seeds, which increased only by 6,8% for period of 2010-2017. But agricultural factor income per annual working unit has considerably increased by 27,2% for period of 2010-2020, mostly approximately closed to same period. This means that factor income increased more than this could be explained by low level of increase according to increasing rate of price indices of output in the EU-28. The agricultural income, factor income per AWU (annual working unit) is valid for all of agricultural production also beyond cereal and seed production. According to the motivation and background the productivity of agricultural industry is basic issue to ensure sustainability of agriculture, which is accompanying with irrigation innovation. Analyse the irrigation prosperity for the increasing output.
The study focuses on the analysing the above-mentioned economic conditions, namely price indices of means of agricultural production, price indices of agricultural products, agricultural factor income per annual working unit in cases of Spain and Portugal with comparing some selected EU member states, namely Hungary, Czechia, Slovakia, Romania, Bulgaria and Slovenia based on inputs and efficiently using renewable water resources. At present the scarcity of water emphasizes the importance of

efficient allocation of water resources based on the productive water management. The sustainability for the agricultural production is based on two main balances, namely

- the first is the profitable agricultural production to keep balance between the production cost and benefit or input and output ratio by satisfactory price income and agricultural factor income.
- The second is to keep balance between the used natural resources and sustainability of the natural environmental background for the agricultural production. Farmers and producers can use natural resources, which can regenerate.

The global warming has the negative effects on the agricultural production even by long and frequent drought periods, which challenges make agriculture save scarcity water. The efficient water use is sensitivity issue, which is accompanying with the efficient irrigation.

The greatest benefit of using *irrigation* is in increasing the *productivity* of all the factors involved in production, particularly the land and labour force. *Water management* and usage, regardless of farm size, are the responsibility of farmers. These responsibilities include managing infrastructure for irrigation, building infrastructure for collecting and storing rainwater, the proper use of different technologies, managing water surplus, and complying with standards on the use of aquifers. Giving more attention to obtaining a higher return on investment is a priority, in order to boost the capacity of *human resources* at all levels, since the change that is needed depends on them to a great extent. This chapter addresses the following *aspects of innovation*: i) innovation for more efficient use of water on farms via pressurized irrigation systems; ii) innovation for reducing energy consumption for water usage on farms; iii) progress made in water harvesting at the farm and community levels (p. 34)(IICA,2015).

Agricultural practices, such as soil management, irrigation and fertilizer application and disease and pest control are related with the *sustainable water management* in agriculture and protection of the environment. Socio-economic pressures and climate change impose restrictions to *water allocated* to agriculture. The adoption of sustainable water management in Mediterranean is not only a technological problem but involves many other considerations relative to social behaviour of rural communities, the economic constrains, or the legal and institutional framework that may favour the adoption of some measures and not others (Chartzoulakisa – Bertaki, 2015).

Increase *water use efficiency*: Can be achieved with the obligatory use of localized irrigation systems by the farmers (with or without subsidies), the proper irrigation scheduling according to actual needsof the crops, the establishment of a system for advising farmers on their irrigation schedules, the introduction of appropriate agronomical practices and the application of salinity management techniques. Water pricing policy, for proper water pricing volumetric water metering and accounting procedures are recommended. Progressive, seasonal and over-consumption water tariffs as well as temporary drought surcharges rates contribute to water savings and should be promoted. Furthermore, it could affect cropping patterns, income distribution, efficiency of water management, and generation of additional revenue, which could be used to operate and maintain water projects. (Chartzoulakisa – Bertaki, 2015; Liao et al, 2007; Tsur-Dinar, 1997).

Agricultural water productivity ("crop per drop") is a partial productivity measure of economic performance that focuses on a single input, water use, and water productivity is affected by the farmers' managerial abilities, environmental conditions among other factors (Vrachioli et al, 2016; more Scheierling 2016; Chakravorty - Roumasset, 1991; Baietti et al, 2012).

Naturally the study focuses on the economic analyses for the price indices of agricultural input and output concerning the agricultural factor incomes mostly in Spain and Portugal comparably with other EU member states of this study, but the water management and irrigation system should be innovative first to develop production. Therefore, some main issues were mentioned above about importance of water management and advanced irrigation system, even the negative effects of global warming on the agricultural sector. The agricultural producers can implement their agricultural production in order to realise their adequate factor income and in order to stay and remain in their original places or establishments.

MATERIALS AND METHODS

The study focuses on the comparing price indices of the means of agricultural production inputs and

price indices of agricultural products output concerning the agricultural factor income per AWU and agricultural total labour force input in period of 2010-2020, where the 2010 = 100. The compering among the economic factors is based on statistical analysis. The Eurostat provided main data for comparing the declining trend of the agricultural total labour force, as annual working unit in selected countries, while factor incomes per AWU could increase. By one hand because of intensive agricultural mechanization decreased the employed labour forces in agricultural sector and by the other hand in the same time the agricultural subsidies increased for further agricultural modernization. Therefore, the innovation in agricultural and irrigation modernization by increasing factor incomes for agricultural producers and farmers can lead to strengthen the sustainability.
The share of the agricultural sector was 2,65% of the Spanish GDP, while Andalusia ranked as the region with the largest cropland area with 3,6 million hectares in 2019. Castille-La Mancha andCastille and Leon followed second and third, respectively. Andalusia also leads the Spanish agricultural production value, far ahead of the other autonomous communities (Blázquez 2021; Eurostat 2021).

STATISTICAL ANALYSIS AND GRAPHICAL PRESENTATION

The statistical analyses accompanying with the geographical conditions of selected countries show main elements of economic-income conditions of agricultural producers as title of annual working units. The AWU means the fulltime workers including some part-time workers added to full time workers. Therefore, the statistical data under AWU calculate only full timeworkers to make the analyse be simply unified method, which make also the analyse and compare among countries in this field be easier (Vidal-Macuaa et al 2018).

Table 1. Price indices of the means of agricultural production Input and Price indices of agricultural products Output and Agricultural income Factor income per AWU, 2010 = 100, and Agricultural total labour force input (1000) in period of 2010-2020

	Price indices of the *means of agricultural production* Input	Price indices of *agricultural products* Output	*Agricultural income* Factor income per AWU	*Agricultural total labour force* input (1000)		
	2010 = 100					
	2010-2017		2010-2020	2011	2019	2019/2011
Czechia	8,4	20,0	50,26	106,20	102,02	-4
Hungary	16,1	15,0	104,24	436,95	358,89	-18
Romania	12,0	12,5	20,65	1532,00	1402,00	-8,5
Slovakia	-1,2	0,4	9,05	57,40	44,50	-22
Bulgaria	3,5	10,5	146,2	375,80	190,40	-49
Slovenia	7,8	5,0	27,5	77,99	77,31	-1
Portugal	12,1	0,4	34,12	299,14	234,42	-22
Spain	9,4	4,9	44,6	903,31	854,70	-5
EU-28	**9,7**	**6,8**	**27,2**	10099,80	9033,59	**-10**

Source: Eurostat, 2021, (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01) EU-28 including UK

Based on the data the productivity can be calculated by out/input the profitability can be calculated by price income / output. The income able can be calculated by agricultural incomes / agricultural total labour force input and also the factor income / AWU.
The statistical data focuses on factor income, because each kind of economic activities concerning different kinds of sectors or branches within agricultural companies or farms can provide some incomes for farmers or generally for AWU. The data added incomes from all of branches of producers,

as animal husbandry, crop production and services.

Note:
Price indices of the *means of agricultural production, input* (2010 = 100) - annual data [apri_pi10_ina] Last update: 08.02.21 Source of data: Eurostat, P_ADJ: Nominal index UNIT: Index, 2010=100 PRODUCT: Goods and services currently consumed in agriculture (Input 1)
Price indices of *agricultural products, output* (2010 = 100) - annual data [apri_pi10_outa] Last update: 08.02.21 Source of data: Eurostat. P_ADJ: Nominal index UNIT: Index, 2010=100 PRODUCT:
Economic accounts for agriculture - *agricultural income* (indicators A, B, C) [aact_eaa06] Last update: 09.04.21 Source of data: Eurostat. ITM_NEWA: Indicator A: Index of the real income of factors in agriculture per annual work unit (AWU) UNIT: Index, 2010=100
Agricultural labour input statistics: absolute figures (1 000 annual work units) [aact_ali01] Last update: 04.03.21 Source of data: Eurostat, ITM_NEWA: Total labour force input

RESULTS AND DISCUSSION

In Price indices of the *means of agricultural production, input* the growth was **9,7%** between 2010-2017, in EU-28 in field of cereals including seeds. Price indices of *agricultural products, output* increased by **6,8%** between 2010-2017, in EU-28. Economic accounts for agriculture, the *agricultural income* increased by **27,2%** in EU-28 between 2010-2020 (Table 1), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01).
In the EU-28 the productivity could have decreased somehow, because the price indices of the *means of agricultural production, as* input increased more than the increase of price indices of a*gricultural products,* as output in field of cereals including seeds, which increased in the same time. But the *agricultural income* factor income per AWU (annual working unit) has considerably increased mostly approximately closed same period. This means that the factor income increased more than this could be explained by the low level of increase according to the increasing rate of the price indices of output in the EU-28. The *agricultural income* factor income per AWU is valid for all of the agricultural production also beyond the cereal and seed production.
This increase of the profitability has only partly been resulted by 10% decrease of number of the agricultural total labour force, as input for this time length. Because the decreasing trend of the agricultural total labour force input was considerable, but subsidies for the agricultural production including the consumption of fixed capital was also significant.
The price indices of the *means of agricultural production, as* input increased by 16,1% in Hungary at the highest level within selected countries in the period of 2010-2017, and the second one by 12,1% in Portugal, which mostly was same as by 12,0% in Romania. This means that the input considerably increased more in these three countries comparably with one of the other selected countries and the average level of EU-28. The higher price level of inputs can more cover the cost of developing the mechanization and the irrigation developed in the basic agricultural production. But this price increase can show that the agricultural production can be more costly than in cases of the other selected countries. Therefore, from this point of view the price indices of a*gricultural products*, as output has important role for calculating cost -benefit ratio in the basic agricultural production. In Hungary the price level of the output has increased by 15% in the same period, mostly by the same rate or closed same rate of input price level. In Romania also the same price increasing rate of the input and output by 12,5%. Themost favourable cost-benefit or input-output ratio was in Czechia, where the price increase of inputwas 8,4%, but the price of output was by 20,0% more than two times more than the price increase of input in basic agricultural production. (Table 1), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06),(aact_ali01).
Also, in *Bulgaria* agricultural producers have favourable position, because the price increase of output was by 10,5%, while the price increase of the input was only by 3,5%, mostly one third of the price increase of the output. In spite that in Bulgaria the price indices of input increased at the lowest level of the selected EU member states and average level of the EU-28, this could probably occur by less developed mechanization, less equipped irrigation system and less used chemicals, as fertilizes and

pesticides. In Bulgaria all of these missing or less used inputs can realise less favourable agricultural basic production, which last one can stimulate more imported products in fields of outputs and also even inputs by increasing the more economic dependence from the highly developed economies. The more increase of the price of outputs can be explained by the less supply of agricultural basic products than the demand of the users and consumers on the domestic market of Bulgaria.
Hungary, Romania and *Slovenia* have considerable increasing price indices of input concerning the emerging investment in their agricultural production, in spite that in *Portugal* the price indices of input were little more than in Slovenia and Czechia, and the Portugal price indices was at the same level as the level of Romania. Price indices of input in Bulgaria was considerably below the level of Portugal. The price indices of input decreased only by 1,2% in Slovakia, while the price indices of agricultural products as outputs increased only by 0,4%. This means that in Slovakia the balance of price increase of input and output was somehow favourable, because the production cost as input decreased more than the price of out increased, namely more income and less cost for agricultural production.
In those countries, where the price indices of the *means of agricultural production, as* input increased, also the price indices of *agricultural products, output* could increase based on the innovative industrial agricultural development, the cost benefit ratio can be unfavourable. Therefore, the increase rate of price in field of the input should be decrease by decreasing production cost level of input for agricultural basic production. The economic measure of input production at firm level should increase mostly in fields of innovative advanced mechanization and chemical production in industry accompanying with increasing level of skilled and educated employees in the agricultural production. The increase of the financial supports for agriculture is obligatory in any case.
In case of *Portugal* the price indices of a*gricultural products* output increased by only 0,4%, mostly this stagnated, while the price of input sharply increased by 12,1%. This condition can lead to more negative financial balance for the agricultural producers. The more increasing problem can avoid by more developing innovation process which can be realised by more subsidies and investment in fieldof fixed capital. In spite that the negative balance of input-output price changes Portugal couldincrease factor income per AWU by 34% more than the average level of the EU-28 as 27,2%. Naturally, the agricultural total labour force as input decreased by 22%, as one of the highest decreasing rates in this field within the selected countries after Bulgaria by 49% and Slovakia also by 22%. The considerable decrease of number of AWU also could contribute to the increase of factor income per AWU in Portugal.
Bulgaria can increase factor income per AWU by 146,2% as top level of selected countries and then in Hungary by 104,24%, which last one could be implemented by moderate difference between price increases of input and output. Bulgaria and Hungary could realise such favourable increase in field of factor income per AWU by ambition development of basic agricultural production, production concentration, mechanization, increasing competitiveness of the sector and former backwardness of income level of AWU. (Table 1), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01).
According to development of *water management* by innovative prosperity of irrigation system in *Spain* and *Portugal* the EU member states can initiate their innovative development of water management based on the objective of the WFD (Water Framework Directive) is to achieve the good ecological status of all water bodies in the EU, maintain and promote sustainable water use in a long- term perspective. Structured in a basin-based management unit, the WFD requires also the elaboration of program measures to achieve the objective of good water status by 2010. River basin management plans (RBMP) have to be implemented in all basins and assure transparency and public participationof all stakeholders involved in the production, review and updating of the plans. The RBMP under preparation in all Spanish basins and the public participation process has been launched recently (CEC2000; CEC 2007; Varela-Ortega 2008).
The global warming and the extending period of drought led to increase the price of the water use also in Spain, which increased by 30% in the first decade of 21st century. These unfavourable economic conditions pressed farmers to decrease their water demands or increase selling price of their agricultural products. Finally, their income decreased by 20% by the end of 2000s (Varela-Ortega 2008). By the end of 2017 the factor income per AWU in Spain could increase by 44,6%, which could be realised by more subsidies to innovative agricultural production and increase of consumption of fixed capital (Table 1; Eurostat 2021), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01).

In Spain the water scarcity was very intensive difficulty in south regions of the country than in central north regions. Therefore, the law system concerning the water supply has permitted more flexible transfer of water from more water supplied regions to the less water supplied regions (see more Mejías et al, 2004).
The water management including water use in Spain can be characterised by some main elements from point of view of the environmental effects, which are as follows (see more Varela-Ortega 2008 and CEC 2007):

- Lower water consumption
- Use of modern irrigation techniques
- Increase in low water demanding crops
- Recovery of the aquifer
- Wetlands are partially restored

Also, there are some main social effects water management at water policy level, which are as follows:
Large adoption rate by farmers
Compensation payments are sufficient

  - Farm income gains
  - Employment increase
  - Social stability
  - Low enforcement cost
  - Low costs
  - High public cost
  - Low cost-effectiveness

In Spain and Portugal, the cost-benefit ratio should be increasing more for the production of agricultural producers concerning the innovative water management with better water supply in order to decrease the price level or tariff for the water use. Additionally, to subsidies for farmers the water management should follow to decrease the press the natural environment, because the over irrigating land will increase the difficulty of saliferous process and the water erosion for soil degradation. The geographical and natural conditions of Spain are similarly to Portugal.
According to Portugal the governmental strategy focuses on the increasing the quality of water management and decreasing the level of vulnerability from the scarcity of water and polluted water resources. From points of view governmental offices created a main project namely the *Integrated De-pollution System of Vale do Ave (SIDVA)*, located in the north-west of Portugal. SIDVA integrates a network of collectors / interceptors, consisting of three drainage fronts, five treatment stations and more than 120 km of collectors, along the main water courses of the River Ave, in a densely occupied area by urban and industry uses, with the predominance of the textile sector. The regional solution wasdeveloped based on the following assumptions **(Francisco da Silva** Costa, 2018):

- Solution defined at the river basin scale (1450 km^2) and not according to administrative limits;
- Joint treatment of domestic and industrial effluents;
- Implementation of the solution in several phases;
- Demanding purification in each treatment infrastructure in order to recover the water quality of the basin;
- Tertiary treatment with removal of the color produced by textile industry;
- Creation of Wastewater Discharge Regulation and tariffs that considered the *polluter – payer principle.*

Spain and Portugal share five river basins: Minho, Lima, Douro, Tagus, and Guadiana. The total area of these basins is 268.500 km^2, which represents about 45% of the Iberian Peninsula, and corresponds to 64% and 42% of mainland Portugal and Spain, respectively (Nesheim et al, 2010; **Francisco da Silva** Costa, 2018). Portuguese-Spanish relations regarding *common river use* have been established through several bilateral legal instruments. These treaties were later complemented, in their territorial scope (broadening to the entire basin and its river banks) and material range (the protection of water bodies and not just their use) by the *Convention on Cooperation for the Protection and Sustainable Use of Portuguese-Spanish River Basins*, signed in 1998 (Albufeira Convention) (APA, 2015; EAA, 2012):

- Systematic exchange of information on plans and projects for new water uses and programs of measures to improve and protect the quality of the water bodies;
- Coordination of water management;
- Transboundary impact evaluation of new projects in the shard river basins;
- Conducting joint studies on the transboundary water bodies;
- Coordination of participation in Community and international programs of common interest.

Within the program the companies should also participate with their own wastewater treatment plants to keep the water resource be clean. Also, the project declared that the need to distribute with equity all users, including industrialists, investments in fixed capital and associated with the implementation and operation of the Integrated De-pollution System of Vale do Ave (**Francisco da Silva** Costa, 2018; Zucco- Costa 013; Kaika 2003)

CONCLUSIONS AND RECOMMENDATIONS

In selected countries of this study the increase of the profitability has only partly been resulted by decrease of number of the agricultural total labour force, as input for this time. Because decreasing trend of the agricultural total labour force input was considerable, but subsidies for agricultural production including the consumption of fixed capital was also significant. The scarcity of the water isa large challenge for agricultural producers even in more extending drought periods, which appeared recently accompanying with more dangerous water flood.

The *cost-benefit ration of farmers* can be improved by the contractual arrangement in order to compensate and balance the negative effects of the water scarcity even in Spain and Portugal. The intensity of the contractual arrangement varies according to the depth and complexity of the provisions in each of the following three areas (see more in FAO 2000):

- *Market provision:* The grower and buyer agree to terms and conditions for the future sale and purchase of a crop or livestock product;
- *Resource provision:* In conjunction with the marketing arrangements the buyer agrees to supply selected inputs, including on occasions land preparation and technical advice;
- *Management specifications:* The grower agrees to follow recommended production methods, inputs regimes, and cultivation and harvesting specifications.

This *contractual arrangement* can strengthen the *agro business connection* among the participants by increasing role of agricultural producers for basic production. The agro business network helps farmers to obtain easier the inputs including the highly developed mechanization and irrigation system based on the environmental technologies, and also, farmers can sell their products by fixed prices determined in the contracts among participants of the agro business network.

The price changes of inputs and outputs for agricultural production should be closed to each other but balance of both of them should ensure more income for farmers by increasing price income for them than the price level increase of inputs. The agricultural production should make less press on the natural background by decreasing negative effects of saliferous and the soil erosion.

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