



SUWANU
EUROPE

SWOT and PEST analyses for implementation of reuse practices in Thessaloniki, Greece

Contents

Socio-economic characterization of the region	2
SWOT Analysis.....	2
PEST Analysis combined with SWOT.....	17
Discussion and conclusion.....	19

Socio-economic characterization of the region

Thessaloniki is the second largest city of Greece. Thessaloniki province is situated at the North of Greece, on the Thermaic Gulf at the northwest part of the Aegean Sea and hosts the second largest metropolitan city of the country. It is bounded on the west by the delta of the Axios river. According to the most recent census data the Thessaloniki Urban Area has a population of 824,676 inhabitants while the Thessaloniki Metropolitan Area has 1,030,338 inhabitants¹. It has an area of 1,285.61 km² (metropolitan area) and is part of the Region of Central Macedonia. Although it is an area with high population density it has also a particularly important agricultural sector. Thessaloniki does not face particular water problems although the large population and the water requirements for irrigation make the area sensitive to water management issues. In addition, the environmental concerns of Thessaloniki residents and municipal authorities make sewage treatment a major issue in the area. The province displays the second largest plain of the country, has abundant surface water bodies (3 rivers, 2 major lakes) and a considerable number of areas under protection status (Nature 2000, National Parks)².

Agriculture represents an important economic sector for the plains surrounding the large urban centre. Intensive irrigated crops such as rice pads, corn, cotton, vegetables and fodder fields³.

Although the severe economic crisis of the last decade (2008 -2018) had caused a lot of negative impacts to the socio-economic profile of the province such as long term de-industrialization and huge unemployment figures⁴, the province still presents some basic advantages that can trigger growth, like the existence of specialized human resources of high educational level and a significant size of production base in primary sector.

SWOT Analysis

The main elements of the SWOT analysis were taken from the first SUWANU (2012) and have been adapted to the new proposed CATEGORIES (Market related, Product related and Social & Governance). This section makes a description of the main findings of SWOT analysis done during the consultation process. Firstly, the already existing aspects from the first SUWANU project have been updated according to the recent situation in Greece. The team members in Greece (from AUTH and ANETH) reconsider the suitability of the previous aspects and identify new ones not included in 2012. Then, the revised SWOT tables was sent to a group of 10 experts (mainly academics) to evaluate and quantify each aspect in a Likert type scale (where 1=not important and 10=very important). Moreover, all the aspects have been grouped by the team members in Greece (from AUTH and ANETH) in several generalised categories and reevaluated by an extended group of 20 experts (10 academics, 3 large farmers, 3 from the local authorities and 4 from the private sector) in a more limited scale (where 1=not relevant and 5=very relevant).

In particular, the relevance of each aspect was determined by an unofficial questionnaire that sent by e-mail to the experts. The different aspects were not translated into Greek as all the 20 experts were familiar with the English language. Once the answers were received the most important aspects were identified and all the comments were discussed by the Greek partners

¹ See table 3.3 of the D.1.1.

² See table 3.12 & 3.13 of the D.1.1.

³ See table 3.15 & 3.16 of the D.1.1

⁴ See table 3.7 of the D.1.1.



considering every aspect. In the following pages, you will see the different aspects classified as internal (strengths and weaknesses) and external (opportunities and threats).

Strengths

General aspects	Specific aspects	GREECE: Thessaloniki Region
Economic aspects (Price)	Geographical aspects	S11. Thessaloniki province has an array of strategic advantages due to its geographical position and characteristics. The metropolis is surrounded to the west and North-east by the 2 nd largest plains of the country. It hosts the 2 nd largest urban complex of the country, the 2 nd major port of the country and the 2 nd industrial site of the country.
		S12. The Thessaloniki Water Supply & Sewerage Company S.A. operates 2 large WWTPs located at the West and East of the urban complex respectively and has already taken initiatives for the re-use of the reclaimed water for irrigation. The company has a secure financial base and invests on upgrading its treatment plants for complying with the quality standards set by the respective laws.
		S13. The crops production pattern to the plains of the area (rice, corn, cotton, vegetables) imposes a huge demand for large quantities of irrigation water
		S14. The mussel's cultivation of the west of Thermaikos gulf area is well developed (80% of the country's output) and musts a constant pressure for adequate quality of the recipient waters were the WWTPs discharge.
	EU funds	S15 The funds available by the various EU funded programmes in conjunction with the environmental policies that are applied through these programmes provide a promising base for introduction of new additive solutions to the scheduled for construction new waste water treatment plants.
Technology (Knowledge/ technology)	Previous successful experience	S21. The Thessaloniki Water Supply & Sewerage Company S.A. in joint action with the department of water resources and land reclamation institute of the National Agricultural Research Foundation (N.Ag.Re.F.). have accumulated considerable experience in re-use of reclaimed water for irrigation.
		S22. There are examples of other WWTPs (Hospital Units) that have implemented commercially available technologies for re-use of the reclaimed water for irrigation of green landscapes.

Health aspects (Enhances water quality)	Water quality	S31. The quality of the reclaimed water as an effluent of WWTPs has been constantly improved during the last decade in compliance with the limits set by the legislation. The same goes for the credibility of the monitoring system for the quality checks.
		S32. The pressure on the groundwater bodies from the numerous water drills, alongside with agrochemical residues, and sea water infiltration to all shoreline fronts have seriously downgraded the quality of this “traditional” water source, making the WWTPs effluent an appealing alternative.
		S33. There is a considerable number of private sector companies that offer commercial tested technologies and solutions for securing the quality of WWTPs effluents to the limits required for re-use at crops irrigation.
Markets (Market demand)	Market share	S41 The up to now paradigms of re-use of WWTPs effluent at irrigation display the same level of cost in the case of “Sindos” treatment plant. Elsewhere in Greece the re-use of treated wastewater is either free of charge either, very low or thus very competitive prices.
		S42. The administrative control of the legislation implementation for the WWTPS operators is constantly improving, thus driving to the increase of the offer of high-quality treated water for the end users at lower prices.
	Market competition	S43. The continuous Introduction of new and improved performance treatment systems by the relative private sector tends to further reduction of operational costs, which leads to lower price tags for the potent end users.
Research and technology transfer (Knowledge/ technology)	Innovation	S51 Thessaloniki hosts an array of specialized institutes that are involved in testing and improving the technologies that are applied in water treatment, water management and water quality control issues
		S52. The strong reliance on tourism in the Thessaloniki wider area in a driving force for keeping the littoral waters in prime condition. Valuable side effect of this trend is a vibrant sector of local SME’s that keep the innovation flow high in all technologies concerning the waste water treatment

	Research	S61 The various schools of the Aristotelian University of Thessaloniki as well as the rest other relative research institutes offer a long experience in EU projects based on research and extension of new technologies in waste water treatment.
	Technology transfer of knowledge	S71 The Centre for Research and Technology-Hellas (CERTH) has as its primary purpose the transfer of mature technologies into the producer’s knowledge. For that purpose, one of its most important tasks is the linkage of the researchers with the entrepreneurs. S72. There are many EU projects under implementation in the area focused in better use of the water resources (SuWaNu – Europe, BestU, Aqua-lity, LYSIS)
Environmental aspects	Impacts	S81 Increase of sensitivity about water resources safety and availability by all groups of citizens (farmers, consumers, travellers etc. S82. The in-force Management Plan for the Water District 10 (in which Thessaloniki province belongs), that has set specific goals for water resources qualities improvement and availability of quantities improvement.
	Land Use	S83 Optimal use of agricultural land. No on-farm buffering needed (compared to water basins for rainwater)
Governance	Legislation	S91 According to the current legislation, not extra treatment needed
Market related	Enhances water availability	S101 By reusing water, it reduces pressure on groundwater and surface water resources
	Continuous supply of water resource	S102 Even in periods of droughts, there is a supply of treated wastewater
	Constant water quality of water resource	S103 The water quality of effluent water of large-scale WWTP stays constant (predictable)

Weaknesses

General aspects	Specific aspects	GREECE: Thessaloniki Region
Economic aspects	Reclaimed water cost	W11. The specific treated water networks that should be build according to the legislation generate new infrastructure expenses W12. The imposed need for secure online quality control of the reclaimed water generates the need for installation of additional monitoring mechanisms that require expenses for procurement and trained stuff to operate them
	Competitiveness	W13. High competitiveness for the water resources with other users other than agriculture (industry, households, nature...). Competitiveness with industry for the reuse of water (they need water the entire year + more capital for investments + less risks for food security or environmental contamination ...)
	Energy costs	W14. The dominant methodology chosen for the majority of the WWTPs is that of the extended aeration, a method that leads to significant electricity consumption. This inserts considerable added value to the output reclaimed water and sets serious cost issues both for the WTP operators and the potent end users
		W15 Energy costs related to water transfer needs from output sites to the site of the irrigated farms
Technology	Previous controversial experiences	W21. The re-use of the output from “Sindos” WWTP for irrigation (about 2.5 million m ³ / year) has been stopped for the recent 5 years due to excess salinity of the treated water cause by the infiltration of sea water to the sewage network at the seafront line of the city
		W22 The huge number of “private” water drills at the farms that provide an irrational autonomy to the farmers for irrigation at will.
Markets	Competence	W31 Very low competence at the plains surrounding the lakes at North of Thessaloniki for providing treated wastewater to the local farmers
	Market size	W32 The market size for treated wastewater end users is quite large especially at the plains west of the city. The abundant surface water bodies of the area act as a barrier for the widening of the use of the reclaimed water
		W41 Weak linkage among research organizations and operators of the WWTPs

Research and technology transfer	Innovation programs	W42. Low interest of the operators of the small size peripheral WWTPS for joining innovation programs when contribution of funds is required
	Buffering of water	W43. Infrastructure needs to buffer water
Water availability	Water availability for treatment	W51. The small sized WWTPs around the metropolis are usually understaffed and very often display poor results to the proper operation of the facilities. Very often the effluent lacks the quality criteria set by legislation making unthinkable the idea of the re-use
		W52. In certain areas the construction of WWTPs is under planning or under implementation, and the prospect of the re-use of the effluent is not foreseen to the construction planning
	Water demand	W53. Discontinuous demand from agriculture (only during period of droughts).
Water quality	Private standard	W61. High uncertainty the water resource does fulfil the requirements of the private standards
	Variable quality of water resource	W62. Small-scale WWTP deliver variable quality of effluent
	Food safety	W63. Not suitable for food (unsafe)
Governance	Legislation	W71. Uncertainty about future legislation concerning water reuse in agriculture. unclarity about implementation of reclaimed water in Manure decree (MAP)
Environmental aspects	Ecology	W81. The use of the water resources generates negative impact on environment (ecology). The use of reclaimed water will reduce the discharges in rivers (affecting the ecology. Risk for soil contamination with heavy metals....

Opportunities

General aspects	Specific aspects	GREECE: Thessaloniki Region
Regulations	European	O11 European subsidies under Common Agriculture Policy that form a guaranteed economic base for farmers and is strongly influenced by agro-environmental actions.

	National	O12 Non-severe restrictions for specific crops cultivated in Thessaloniki such as cotton or crops that normally undergo thermal treatment before human consumption (rice, sugar beet)
		O13 The National Strategy Frame, as it has been announced by the National Waters Committee, for confronting water resources limitations (scarcity, drought, etc.) foresees policies for developing alternative water resources such as re-use of treated waters
	Regional / Local	O15 The in force revised Management Plan for Water District 10 predicts measures that refer to extensive water re-use to confront the challenges of water resources deficit
		O16 The major water resources manager of the area which is Thessaloniki Water Supply and Sewerage Company SA (EYATH S.A.) is already heavily involved in actions to further exploit the resources that it manages
		O17. The procedures for defining a specific Mussel Growth Area at the estuaries of the three rivers at west of Thessaloniki and the regulations at regional level for controlling the waters quality can lead to measures for enhancing the use or reclaimed water to relieve the pressures from using river flow quantities for irrigation
		O18. A future review of the action plan to restore Lake “Koronia” could predict measures for increasing the use of alternative water resources such as reclaimed water to relieve the pressures for surface and ground water abstractions in the area for irrigation use.
Economic aspects	Reclaimed water cost compared with freshwater	O21 The reclaimed water cost is mainly depended by the quality limits set by legislation and the installed technologies at the WWTPs. It is paid by the wastewater producers (urban population) and thus the merging costs for its re-use in irrigation is that of infrastructure and energy for transfer. In certain areas (east of Thessaloniki) where the irrigation water is pumped from significant depths the reclaimed water is more attractive due to lower cost
	Energy cost	O22 Significant increase in energy costs generating serious limitations in the use of groundwater in some areas
Social aspects	Public awareness	O31 Implementation of Information & training programmes for farmers on new methods and technologies that lead to better exploitation of the resources used in agriculture

		O32 Implementation of information & training programmes for WWTPs operators, farmers associations & Local Land Reclamation Agencies managers for the necessity to develop new alternative water supply sources in order to tackle drought phenomena
	Other aspects: Management Authorities of the Protected Areas	O33 The Management Authorities of the Thessaloniki protected areas (National Parks, Nature 2000) are responsible for developing and implementing management plans that secure the best possible ecological status for the protected areas. The proper use of reclaimed water for irrigation represents a flexible tool for maintaining the water balance whilst satisfying the production requirements.
	Public opinion	O34. Positive attitude of consumers
Agriculture	Water scarcity for agriculture	O41 Necessity to develop new alternative sources of water due to water scarcity in agriculture
		O42. Possibility to exploit good quality treated wastewater from settlements in semi-arid & sloped areas
		O43 Mitigation of the effects of climate instability as factor in the reduction of rainfall and the necessity to secure irrigation in areas with high capital investment in intensive agriculture e.g. rice pads
	High value agriculture products	O44 Some dynamic crops in the region of Thessaloniki like rice pads on the western plains & olive grows in the north-eastern slopes that face a future increase demand by the global markets probably will be able to afford high water prices.
	Nutrients	O45 In some areas like the plains around the two lakes where the Nitrogen overload of the soil needs to be controlled the solution of regulating the nutrients via the irrigation bure-claimed water is appealing
Technology	External collaboration	O51 The introduction of a cost-effective technology that secures the quality criteria set by legislation san accelerate the use of reclaimed water
	New and cheap technologies	O52. Might enhance the cost-effectiveness and implementation
Markets	Potential markets	O61 Low introduction of the reclaimed water in some crops as olive grows and rice pads (agriculture products mend for consumption after processing)

Research and technology transfer	Technology transfer of knowledge	O71. Implantation of irrigation advisory services in irrigation districts located in western Thessaloniki by the Local Institute of Water & Soil resources & Land Reclamation allowing the further expansion of irrigation areas with reclaimed water
Water availability	Groundwater	O81 Thessaloniki faces already some serious limitations in groundwater supply especially in its Eastern part (river Antemountas Valley & “Kalamaria basin” due to overuse and salinity caused either by sea infiltration or ancient saline water underground cups
	Location of water availability	O82. Both the 2 major installations of the Thessaloniki Water Supply & Sewerage Company S.A. are located close to irrigation water demanding areas. Also, The WWTP of Langadas Municipality is located to the centre of the north plains of the prefecture.
Environmental	Environmental limitations	O91 Significant increase in water requirement for environmental uses in Eastern Thessaloniki (Kalamaria Basin) is a factor that will lead to lower availability of fresh water for agriculture
	Climate change	O92. Increased drought occurrence will affect the urgency for alternative water sources
Policy	Water priority plan	O101. The priority plan might give the agricultural sector less access to 'classic water resources'. This will enhance the need for alternative water sources such as reclaimed water
	Political willingness	O102. Willingness to implement
		O103. To have good agreements between farmers (and WWTP) to distribute water

Threats

General aspects	Specific aspects	Your region
Regulations	European	T11 More austere regulations of levels of E. coli for reclaimed water in crops meant for human consumption
		T12 Further restrictions in the use of reclaimed water in some European countries
	National	T13 Adoption of more austere regulations of levels of E. coli for reclaimed water crops meant for human consumption

	Regional / Local	T14 The time-consuming legislation process at national level alongside with the cumbersome established regional management system were the decentralized Region plans and the elected Region implements. T15 The regional adoption of more severe regulations of levels of E. coli for reclaimed water in crops meant for human consumption
Economic aspects	Reclaimed water cost	T21 Systems with elevated costs will not be attainable for a the peripheral WWTPS and will face strong opposition for the large ones
	Other aspects:	T22. Weak interest of farmers or WWT suppliers
Social aspects	Public acceptance	T31. Uncertainty in the public acceptance of reclaimed water in the Thessaloniki area/region
	Social communities	T32. In eastern Thessaloniki the dispersion and low size of the fields candidates to use reclaimed water
	Cooperation	T33. Disagreement between various parties
	Food safety	T35. Risks towards food safety
Agriculture	Agriculture of low-input	T33. Due to the low profitability, introduction of practices of agriculture of low-input reducing or eliminating irrigation
	Water requirements	T34. Crop water requirements are higher than the available reclaimed water. The salinity levels of the wastewater of the metropolis (probably to sea infiltration) caused the drop of the use of the reclaimed water during the last 5 years
Technology	Success of other technologies	T41 The use of heavy infrastructures of the past (small height dams to the riverbeds), provide a relative secure and cheap source of irrigation water.
	Other aspects	T42. Uncertainty about effective treatment of emerging risk nanoparticles, antibiotics, ...
		T43. The use of water in agriculture will need intensive treatments
Markets	Commercial conflicts	T51 There is a growing tendency to the promoters of foods to use health associated concerns to promote product under the umbrella of “Pure and untreated straight from nature”. This provide a negative ground for promoting the idea of re-use of reclaimed water for foods production

Water availability	Water availability for treatment	T61. In some areas around the metropolitan centre the construction of WWTP is under implementation or under schedule, thus there is low availability of water for treatment in numerous areas
Environmental aspects	River flow	T71 The “Mygdonia basin: with the two lakes has a more restrict legislation concerning the maintenance of the outflow from the lakes to the sea. The river “Richios” is in a protected area that gives priority to its flow against irrigation
	Other aspects:	T72. Heavy metals, nanoparticles, plastics...
Policy	Political willingness	T81. No vision to implement this practice

As described above, the second questionnaire (included grouped SWOT categories) was sent to 20 experts in reclaimed water sector during June 2019 for the evaluation of the relevance of the different aspects, classifying them from 1 (not relevant) to 5 (very relevant). The experts who answered the questionnaire belong to the following groups: Academics or researchers (10), large farmers (3), representatives of local authorities (3) and representatives of the private sector (4). Answers are described below:

Strengths

This category has been received the highest average score (3.6) by the group of experts. In particular, half of the grouped items are defined as “5-Very relevant” or “4-relevant” while the rest ones are received an average score equal or lower to 3. According to the experts’ point of view the among the most important strengths (score=5) are mentioned the “knowledge/technology” and the “water availability” following by (score=4) the “market demand” and “constant water quality”. On the other hand, as less important strengths (score=3) are characterized the “water quality”, the “land use” and finally (score=2) the “legislation” and the “price” (Fig. 4).

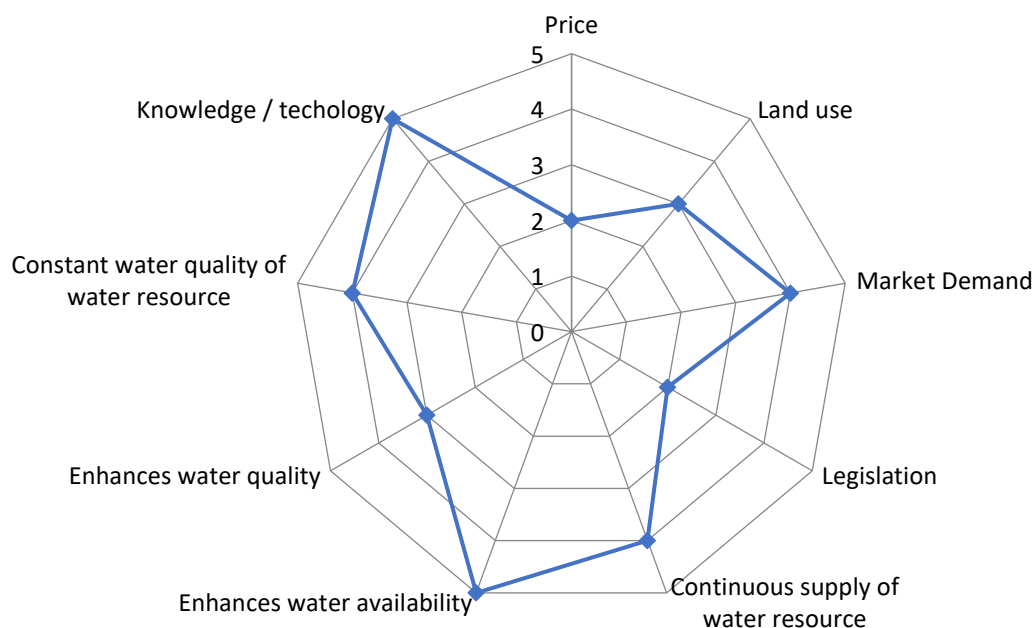


Figure 4: Strengths relevance

Weaknesses

This category has been received the second highest average score (3.6) by the group of experts (same score as the threats). Among the most important and relevant weaknesses, the group of

experts have been identified (score=5) the “water demand” and the “legislation”. Following, as relevant (score=4) weaknesses have been mentioned the “private standards”, the “energy consumption” and the “buffering of water”. Finally, the rest grouped weaknesses “cost”, “food safety”, “ecology”, “competitiveness” and “variable quality of water” have not been rated as “5-very relevant” or “4-relevant” ones (Fig. 5).

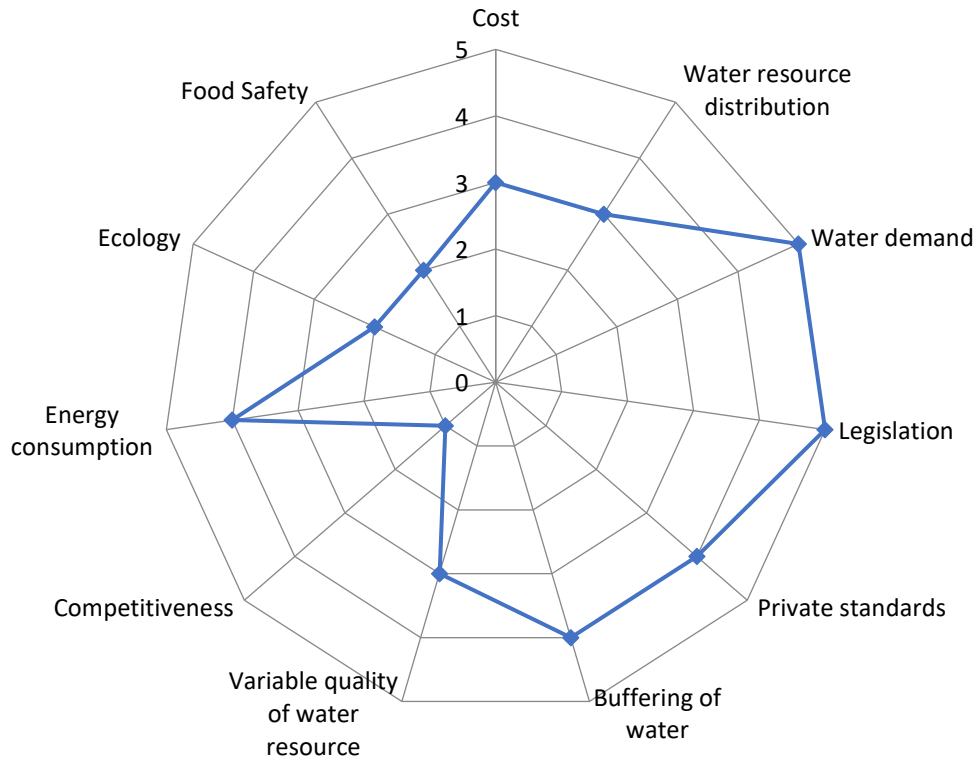


Figure 5: Weaknesses relevance

Opportunities

This category was received the lowest average score (3.0) by the group of experts. According to the experts’ responses, only the “legislation” has been mentioned as “5-very relevant” opportunity. “Business model development”, “drought occurrence” and “new and cheap technologies” have been rated as “4-relevant” and all the rest opportunity elements have been rated with 3 or less weight. More specifically, the “set-up of water committees” and the “inventarisation (local) water needs” have been scaled in the middle order (3) while the “water priority plan”, the “market demand”, the “political willingness” and the “ASR” has been evaluated as “2-rather irrelevant” and finally only the “positive public opinion” has been evaluated as “1-not relevant” (Fig. 6).

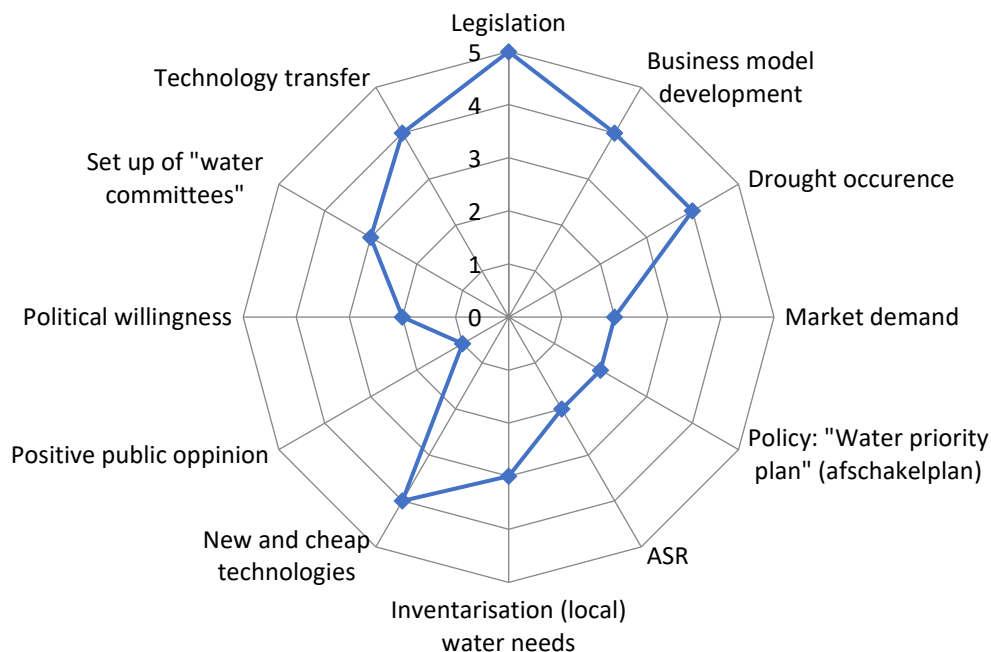


Figure 6: Opportunities relevance

Threats

The category was the latest to be analysed and received the second highest average score (3.6) by the group of experts (same score as the weaknesses). Only one aspect, the “treatment identity”, received a score greater than 4. Four aspects received a score equal to 4 (“fragment approach on legal level”, “co-operation”, “technological inefficiency” and “negative public opinion”), three aspects received a score equal to 3 (“market demand”, “competition industry” and “legislation”) while three aspects received score equal to 2 (“risks towards food safety”, “risks of contamination” and “political willingness”) (Fig. 7).

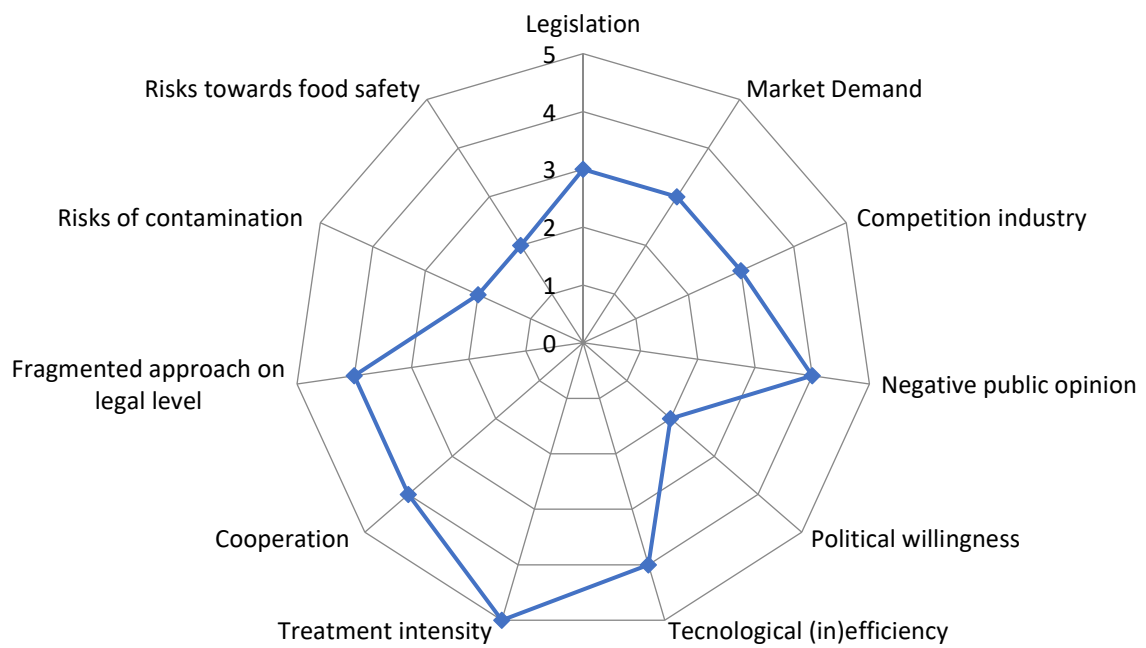


Figure 7: Threats relevance

PEST Analysis combined with SWOT

PEST factors, referring to political (P), economic (E), social (S) and technological (T) determinants. PEST analysis complements the SWOT analysis by inserting each of the four components of SWOT analysis in the second dimension and generate a table with two classification factors. Some examples of this combined use are (Singh et al., 2018), (Ha and Coghill, 2008).

PEST \ SWOT	Strength (S)	Weaknesses (W)	Opportunities (O)	Threats (T)
Political aspect (P)	<ul style="list-style-type: none"> Public policy (e.g. License Scheme) Cooperation between the public and private sectors 	<ul style="list-style-type: none"> Slow licensing process 	<ul style="list-style-type: none"> Political willingness 	<ul style="list-style-type: none"> Cyber terrorism Security breach
Economic aspect (E)	<ul style="list-style-type: none"> Economic policies (e.g. Circular economy) Funds for to improve social and physical infrastructure High productivity of water. 	<ul style="list-style-type: none"> High cost WW Unemployment 	<ul style="list-style-type: none"> EU circular economy 	<ul style="list-style-type: none"> Contamination event trigger reaction against WW
Social aspect (S)	<ul style="list-style-type: none"> Educational system (e.g. availability of labour) Good vertebrate in rural areas urban-farmers 	<ul style="list-style-type: none"> farmers are older generation are computer illiterate 	<ul style="list-style-type: none"> Environmental concerned society 	<ul style="list-style-type: none"> 'Urban' society against irrigation (loving more ducks than farmers)
Technological aspect (T)	<ul style="list-style-type: none"> Tech based farm sector Innovation 	<ul style="list-style-type: none"> Some urban government are business unfriendly ... 	<ul style="list-style-type: none"> Low cost technologies 	<ul style="list-style-type: none"> Technical problems will disrupt the entire networks

Discussion and conclusion

According to the analysis, in the case of Thessaloniki, the positive SWOT aspects (Strengths and Opportunities) are more than the negative ones (Weaknesses and Threats). However, when grouping the SWOT elements and evaluating them, by a group of experts, we notice that both the weaknesses and the threats are significant and with high weights. On the other hand, the grouped strengths and opportunities have been received the highest and the lowest average scores respectively. More specifically: a) the most important categories of the “Strengths” are related to “Knowledge/Technology” and “Enhances Water Availability”, b) the most important categories of the “Weaknesses” are related to “Water Demand” and “Legislation”, b) the most important categories of the “Opportunities” are also related to “Legislation” and finally d) the most important categories of the “Threats” are related to “Treatment Identity”.