

Unfolding Policy Goals and Means of the Nexus Water-Energy-Land-Food-Climate in Greece

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Abstract

Social welfare and economic prosperity are strongly linked to the sustainable management of natural resources. The present paper focuses on policy analysis process and its pivotal role in decision making for the efficient management of the available natural resources. In this context, we identify, analyze and assess several policies concerning the nexus water-energy-food-land-climate and the existing interrelations among these components. Policies regulating the agricultural and tourist sectors are also analyzed. A compact methodological framework guides policy analysis process on the basis of which, we investigate individual policy areas, goals, means and potential interactions among policies. The key research questions concern: a) the harmonization of the national and European legislation, b) the exploration of goals and targets of policies dealing with water, energy, land, food, climate and c) the exploration of means supporting the implementation of the aforementioned goals. Special emphasis is placed on: policy priorities for the efficient exploitation and use of resources; policy measures for the implementation of the respective priorities and; future strategic options for the sustainable management of the nexus components. The exploration of the policy papers helped us form a clear picture for future strategic directions and goals to be accomplished. Of utmost importance was stakeholders' involvement that shed light on several knowledge gaps that came into question during the policy analysis process. It became clear that the engagement of stakeholders is necessary as they supported policy investigation by offering their knowledge, experience and expertise. Our next steps include the study of policy coherence among the nexus-related policies.

Keywords: policy inventory, nexus, stakeholder engagement, legislation, Greece

Introduction

People's quality of life at any scale level (regional, national, European, global) depends on the availability of natural resources as well as their rational exploitation. Water, land, energy, food and climate are the main components incorporated in policy priorities aiming at an efficient use of resources and constitute a nexus, an integrated system with direct and indirect interlinkages among its components. Putting pressures to one component of the nexus implies pressures to all the other components. Additional pressures are put by the increase of global population and urbanization, new consumption patterns in water-energy-food, abandonment of agricultural land etc. Also, of exceptional importance is the need for adaptation to climate change through the adoption of respective policies and mitigation strategies.

In this context, future decisions will be formed according to the three basic pillars of sustainability, namely: environmental protection, social cohesion and economic efficiency. Policy making represents a crucial stage in the planning and decision making process. It sheds light on the main strategic directions for the design and implementation of future scenarios. Also, apart from the individual characteristics that any policy incorporates, interactions among different policies are explored as possible changes in one sector entail impacts to the others. However, existing knowledge gaps as well as imprecise and vague information are the basic barriers for decision makers when dealing with the design of future policies. As such, there is a strong need for attaining policy coherence through the formulation and adoption of concrete policies that place emphasis on the integrated and sustainable resource-use. Towards this direction, reconciliation of global, European and national policies is important while the impacts derived from pressures put on natural resources play a key role in defining policy priorities and goals.

The present paper focuses on the exploration of the existing policy framework underpinning water, land, climate, energy and food in Greece. Through a policy inventory process we collect several policy papers concerning water resources management, land use and climate regulation, food security,

energy resources management, agricultural and tourist sectors. Resource- and nexus-related policies are deeply explored and analyzed. Firstly, policy goals were unfolded while at a second step policy means supporting the implementation of the respective goals were identified. Moreover, policy analysis sets the framework upon which investigation of possible synergies, conflicts and trade-offs among policies took place. Key research questions were investigated such as: a) the level of coherence among policies, b) the management of knowledge gaps and c) the role of stakeholders' engagement during the policy analysis process. The ultimate goal was to gain a deeper understanding of the policies related to the nexus and the policy framework under which projects and future plans will be implemented. The reconciliation of the national policies with the global and European legislative framework and the adoption of global and European policy targets to local situations were also explored. It should be mentioned that in this effort, stakeholders' engagement is substantial to gain further knowledge on these issues. Except for knowledge concerning the nexus-related policies, stakeholders enrich the policy analysis process by offering a pull of various opinions and aspects about sustainability issues and assessment [1].

Inventory of the nexus-related policies

Policy framework sets the rules and reflects decision makers' choices for the development of productive sectors. In other words, it determines the conditions under which several actions may take place (what is allowed – what is prohibited) through the formulation of an administrative, regulatory and operational framework that is mainly binding. Especially, when we are referring to the legislative framework, we are talking about binding rules and principles aiming at social and economic welfare as well as the protection of natural environment. In addition, priorities for future development and future strategic opportunities are also included.

Policy framework incorporates both a spatial and a temporal scale. Spatial scale concerns the geographical extend and thus a policy may be characterized as regional, national, European or global. The larger the spatial scale the more general the content of the respective policy. Also the time horizon of a specific policy until the accomplishment of its goals or the revision of its content is equally important. The European Union has adopted several global policies and conventions while it has also established a common policy/legislative framework binding for its Member States. Each Member State adopts immediately the binding EU policies whereas the adoption of non-binding policies is not compulsory.

In this paper, we were focusing on screening the nexus-related policies in Greece in order to create a policy inventory. In this context, issues related to the nexus policy sectors were identified and policies regulating each sector were analyzed. Analysis of interactions among the nexus components such as food-energy-water [2], water-food-energy [3], energy-water, water-energy [4] are the key points of the policy analysis process. It should be mentioned that identification of policy goals and policy means constitute the first stage for the exploration of policy coherence and possible conflicts. Policy papers that also represent the main economic activities supporting the national income were collected and reviewed (Table 1).

Nexus component	Policy issues investigated
Climate	<ul style="list-style-type: none"> – Sustainable management of emissions / GHG emissions – Adoption of International and European Conventions on climate change – Adaptation to climate change impacts – Mitigation strategies – Attainment of national energy goals – Resilience against climate change impacts
Water	<ul style="list-style-type: none"> – Reconciliation of the national legislative framework concerning water resources management with the WFD 2000/60/EC – Sustainable management of water resources – Measures and procedures for the integrated protection and management of inland surface waters, coastal water and groundwater – Water quality issues – River basin management plans
Food	<ul style="list-style-type: none"> – Food and feed security – Protection of public health – Protection of animals' health
Energy	<ul style="list-style-type: none"> – Electricity production from RES – Power plants for energy production from RES – Cogeneration of high performance electricity and heat

	<ul style="list-style-type: none"> - Promotion of RES in the internal energy market - National energy goals - RES sharing in the final gross energy consumption - Internal gas market - Differentiation of the national energy mix - Energy efficiency and energy saving
Land	<ul style="list-style-type: none"> - Strategic directions for the integrated spatial and sustainable development - National strategic framework for spatial and urban planning - Spatial organization of the aquaculture sector - Spatial organization and sustainable development of the industrial sector
Agriculture – Agriculture and food	<ul style="list-style-type: none"> - Sustainable use of plant-genetic resources by the agricultural and food sector - Development of livestock and farming sector - Sustainable use of pesticides - Available grazing lands / pastures - Farmers and existing plots - Agricultural associations
Tourism	<ul style="list-style-type: none"> - Tourist entrepreneurship - Tourist training - Sustainable development of the tourist sector

Table 1 Policy issues investigated per sector

A policy inventory was formed by first defining the nexus sectors that would be investigated and then the key research questions were identified concerning the policy framework that regulates each sector. The main policy issues being dealt with in each policy paper were explored and clarified. In the next steps the identification of policy goals and policy means as well as stakeholders' engagement and stakeholder analysis was performed.

Policy Analysis

The development of a sector and the consequent sectoral activities are strictly regulated by the existing legislative framework and the respective policies. Moreover, policy papers set the goals towards the future development of each sector and the means (policy measures) to attain such goals. The goals reflect future strategic directions and their expecting progress while policy means are the 'paths' leading from the current state to a future desirable one. Thus, future plans incorporate the 'policy dimension' and are designed according to the context of policy/legislative framework. For example, land-use changes are strongly affected by existing land-use policies and also by social, economic and physical driving forces [5].

The exploration of policy papers and the analysis of the policy context helped us identify future perspectives for each sector and the strategic directions concerning the management of natural resources, the level of policy coherence and possible policy conflicts. In Table 2, indicative policy goals and means per nexus component and related sectors are summarized.

Policy area	Policy goals	Policy means
Climate [6], [7], [8], [9], [10]	<ul style="list-style-type: none"> - Limitation and reduction of emissions – GHG emissions - Reinforcement of the country's (Greece) resilience against climate change impacts - Increase climate change adaptation ability - Promotion of actions and policies for the adaptation of all economic sectors (emphasis on most vulnerable sectors) 	<ul style="list-style-type: none"> - Improvement of energy efficiency in several economic sectors - Promotion of research and development in the field of RES - Exploitation of RES for energy production - Use of technologies that 'capture' Carbon Dioxide - Use of innovative and environmental friendly technologies - Market adaptation towards reducing emissions (economic stimuli) - Cogeneration and energy saving - Exploitation and promotion of natural gas for heating and cooling - Installation of central photovoltaic systems - Promotion of biofuels
Water [11], [12]	<ul style="list-style-type: none"> - Reconciliation of the national legislative framework for water resources management with the WFD 2000/60/EC 	<ul style="list-style-type: none"> - Preparation of analytical reports including: the characteristics of each river basin, the possible effects of human activities on surface water and groundwater, the economic analysis

	<ul style="list-style-type: none"> - Protection and management of surface water and groundwater - Sustainable use of water resources - Protection of water resources quality 	<ul style="list-style-type: none"> of water uses in each river basin - Preparation of river basin management plans <ul style="list-style-type: none"> - Identification of river basins' and water districts' characteristics - Preparation of a national register (database) including protected areas - Development of programmes and measures for monitoring water resources status - Establishment of services, committees and administrative bodies, responsible for water resources management
Food [13]	<ul style="list-style-type: none"> - Ensuring security in the food sector - Implementation of the EU and the national legislation in the food sector, fodder sector and the sector of animals' protection and health 	<ul style="list-style-type: none"> - Imposition of penalties in case of offenses in food and fodder industry - Rules and measures ensuring food and fodder security - Monitoring, confiscation, withdrawal or destruction of non-secure food or feed - Constraints and prohibitions concerning the market of animal by-products / sub-products - Compliance measures concerning food and fodder imports from third countries
Energy [14], [15], [16], [17], [18], [19]	<ul style="list-style-type: none"> - Identification of rules and criteria for the sustainable management of RES - Electricity production from RES and cogeneration of high performance electricity and heat in the internal market - Attainment of national energy goals (2020) - Energy production from RES - Increase of RES sharing to the final gross energy consumption - Energy efficiency and energy saving 	<ul style="list-style-type: none"> - Regulation of issues concerning location and installation of RES power plants (spatial and urban plans, special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective strategic environmental impact assessment, etc.) - Definition of special criteria for the installation of wind parks in the mainland and the islands (maximum land cover percentage, minimum distances, protection of the landscape) - Definition of special criteria for the installation of small scale hydropower plants (minimization of visual effect, accessibility) - Definition of criteria for the installation of photovoltaics (barren or low-productivity land, invisible areas, connection capabilities) - Definition of criteria for the installation of biomass/biofuels processing units (next to agricultural areas, large farms, landfills, etc.) - Development and promotion of the natural gas market - Development and promotion of RES use in buildings
Land [20], [21], [22], [23]	<ul style="list-style-type: none"> - Identification of strategic directions for the integrated spatial and sustainable development of Greece for the next 15 years - Development of a national strategy for spatial and urban planning - Development of a balanced and competitive economy (economic development) - Protection of natural and cultural resources - General directions, rules and criteria for the spatial structure, spatial organization and development of the aquaculture sector - National directions for the spatial organization of the industrial sector 	<ul style="list-style-type: none"> - Measures for biodiversity protection - Promotion of entrepreneurship - Land use regulation (spatial organization of several sectors and activities) - Limitation of urbanization - Development of rural regions (increasing complementarity between urban and rural regions) - Improvement of access to transportation, energy and telecommunication networks (relative infrastructures) - Strengthening social infrastructures (education, health, social welfare, etc.) - Promotion of specialization and complementarity among productive sectors

Agriculture [24], [25], [26], [27], [28], [29], [30]	<ul style="list-style-type: none"> - Preservation and sustainable use of plant genetic resources for food and agriculture - Determination of regulations for livestock activities and livestock facilities - Reconciliation with the Directive 2009/128/EC: ‘Establishing a framework for Community action to achieve the sustainable use of pesticides’ - Identification of pastures and grazing lands in Greece - Sustainable development of the aquaculture sector 	<ul style="list-style-type: none"> - Preservation, exploration, collection, identification, assessment and documentation of plant genetic resources for food and agriculture - Register (database) of farms (Ministry of Rural Development and Food) - Enhancement of transparency - Mapping out pastures - Sustainable and rational use of pesticides – Training programmes on pesticide use - Establishment of a National programme for aquaculture development (public involvement during the decision making processes, production of high quality food products, employment, research and development, permission processes, land use regulation) - Creation of a register (database) containing farmers and their plots - Enhancement of agricultural training
Tourism [31], [32]	<ul style="list-style-type: none"> - Sustainable development of the tourist sector - Development of tourist entrepreneurship - Organization of tourist training schools - Promotion of the Greek tourist product (natural and cultural resources) 	<ul style="list-style-type: none"> - Promotion of organized and sophisticated tourist investments - Specific land use regulations for the development of tourist activities - Differentiation of tourist activities and tourist product according to the special characteristics of each region - Establishment of a tourist observatory - Increasing tourist training awareness - Development of alternative tourist activities - Strengthening research in the tourist sector (studies, statistical researches, proposals for the tourist development)

Table 2 Policy goals and policy means

Unfolding policy goals and policy means is the first screening of each policy to understand the basic future directions and the level of policy coherence. Emphasis is also placed on issues concerning entrepreneurship promotion, networking among businesses, reconciliation of the national legislative framework with the EU and global policies, social and economic welfare and, spatial organization of productive sectors. However, extra validation of these primary outcomes is very important based primarily on stakeholders’ expertise to validate assumptions and clarify possible ambiguities

Stakeholder Analysis

Stakeholders’ engagement is of exceptional importance in almost any case of decision making and policy design process. The main reason lies on the fact that stakeholders will be affected by the respective policies while on the other hand, they may have the power and means to affect (reinforce or block) the implementation of a policy that either promotes or blocks their future plans and interests. Stakeholders can also validate several assumptions, offer a deeper insight into the issues studied through their existing experience and expertise and enrich our knowledge stock.

For the purposes of this paper, a preliminary stakeholders’ analysis is conducted in order to support the analysis of the nexus-related policies. Representatives of public and private organizations were invited and involved in order to better understand policy goals and means, the decision making process as well as the content of the relevant policy papers.

Stakeholder analysis resulted in the clarification of several ambiguities emerged during the policy analysis process. Questions like ‘who decides over the management of natural resources?’ or ‘which is the role of the x stakeholder during the policy design process?’ or ‘for what kind of policy issues is the x stakeholder interested in?’ were answered by the respective experts and helped us to better understand the framework under which the policy-design ‘mechanism’ works. In addition, stakeholders raised new issues, underlined existing knowledge gaps and shed light on issues relative to their expertise.

Conclusions

In this study, the national policy framework that sets the terms and conditions for the efficient management of water, land, energy, climate, food and the sustainable development of agricultural and tourist sectors is outlined. Water, land, energy, climate and food constitute a nexus that forms a concrete and dynamic system, characterized by complex interrelations. Putting pressures to one component entails pressures to the other components due to the interactions exist among them.

In this content, we adopted an integrated methodological approach supporting the investigation of policy priorities and strategic directions for the efficient use of natural resources. We firstly collected a number of relevant policy papers containing national policy priorities for the sustainable development of the nexus-related issues, taking also into consideration the general priorities set by EU and global policies. A deep insight in the respective policy papers unfolded several policy goals and policy means concerning each nexus component, often in close relation with other nexus components. In the majority of policy papers several cross-sector references exist as the formulation of policy goals for one component takes into account possible conflicts or complementarities with the rest of the nexus components. The exploration of the policy papers helped us form a clear picture for future strategic directions and goals to be accomplished, under climate change impacts and the respective need for adaptation.

Stakeholders' involvement shed light on several knowledge gaps that came into question during the policy analysis process. It became clear that the engagement of stakeholders is necessary as they supported policy investigation by offering their knowledge, experience and expertise.

Our next steps include the study of policy coherence and the exploration of possible conflicts among the nexus-related policies. This stage will be supported by a relative methodology while stakeholders will enrich the content of our analysis. Possible conflicts among stakeholders will also be investigated as some key stakeholders affect the identification of policy goals, the determination of policy means and the practical implementation of policies.

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References

- [1] Zijp, M. C., Waaijers-van Der Loop, S. L., Heijungs, R., Broeren, M. L. M., Peeters, R., Van Nieuwenhuijzen, A., Shen, L., Heugens, E. H. W., Posthuma, L.: Method selection for sustainability assessments: The case of recovery of resources from waste water. *J. Environ. Manage.* 197, 221-230 (2017).
- [2] Miralles-Wilhelm, F.: Development and application of integrative modeling tools in support of food-energy-water nexus planning – A research agenda. *Journal of Environmental Studies and Sciences.* 6, 3-10 (2016).
- [3] Allan, T., Keulertz, M., Woertz, E.: The water-food-energy nexus: An introduction to nexus concepts and some conceptual and operational problems. *Int. J. Water Resour. D.* 31, 301-311 (2015).
- [4] Schornagel, J., Niele, F., Worrell, E., Boggemann, M.: Water accounting for (agro)industrial operations and its application to energy pathways. *Resour. Conserv. Recy.* 61, 1-15 (2012).
- [5] Wang, J., Chen, Y., Shao, X., Zhang, Y., Cao, Y.: Land-use changes and policy dimension driving forces in China: Present, trend and future. *Land Use Policy.* 29, 737-749 (2012).
- [6] Law 3017/2002: Verification of the Kyoto Protocol in the United Nations Framework Convention on climate change (2002).
- [7] National programme for the reduction of GHG emissions 2000-2010 (2003).
- [8] Law 4345/2015: Verification of the Doha's amendment on Kyoto Protocol in the United Nations Framework Convention on climate change, having been verified by the Law 3017/2002 (2015).
- [9] Law 4426/2016: Verification of the Paris Convention in the United Nations Framework Convention on climate change (2016).
- [10] National strategic plan for climate change adaptation, Ministry of Environment and Energy (2016).
- [11] Law 3199/2003: Protection and management of water resources – Reconciliation with the WFD 2000/60/EC (2003).

- [12] Presidential decree 51/2007: Determination of measures and procedures for the integrated protection and management of water resources in compliance with the WFD 2000/60/EC (2007).
- [13] Law 4235/2014: Administrative measures, processes and penalties for the implementation of the EU and national legislation in the food, fodder and health sectors and protection of animals (2014).
- [14] Decision 49828-2008: Special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective environmental impact assessment (2008).
- [15] Law 3468/2006: Electricity production from RES and cogeneration of high performance electricity and heat (2006).
- [16] Law 3734/2009: Promotion of cogeneration from two or more types of energy – Issues concerning the ‘Mesochora’ hydroelectric power project (2009).
- [17] Law 3851/2010: Acceleration of RES development for combating climate change (2010).
- [18] Law 4001/2011: Operation of electricity markets and natural gas markets – Research, production and transmission networks for hydrocarbons (2011).
- [19] Law 4414/2016: Support of electricity production from RES and high performance electricity and heat cogeneration – Legal and operational separation of natural gas supply and distribution (2016).
- [20] Decision 6876/481-2008: General legislative framework for spatial planning and sustainable development (2008).
- [21] Law 4269/2014: Spatial and urban planning reformation – Sustainable development (2014).
- [22] Decision 31722-2011: Special legislative framework for spatial planning and sustainable development for the aquaculture sector and the respective strategic environmental impact assessment (2011).
- [23] Decision 11508-2009: Special legislative framework for spatial planning and sustainable development for the industrial sector and the respective strategic environmental impact assessment (2009).
- [24] Law 3165/2003: Sanction of the International Convention on plant genetic resources for food and agriculture (2003).
- [25] Law 4056/2012: Regulations for farming activities, livestock and livestock facilities (2012).
- [26] Law 4036/2012: Pesticides market in Greece – Rational use of pesticides (2012).
- [27] Law 4282/2014: Development of the aquaculture sector (2014).
- [28] Law 4351/2015: Pastures and grazing land in Greece (2015).
- [29] Law 3874/2010: Register of farmers and farms (2010).
- [30] Law 4384/2016: Agricultural associations, types of collective organization of the agricultural land (rural areas) (2016).
- [31] Law 4179/2013: Simplification of procedures that support tourist entrepreneurship – Reformation of the Greek Tourism Organization (2013).
- [32] Law 3105/2003: Tourist training and regulations concerning the tourist sector (2003).