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1 *There are 14774 words in this manuscript.*

## 2 Water-energy-food nexus: concepts, questions and methodologies

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### 10 **Abstract**

11 The water-energy-food nexus has gained increasing attention in the research  
12 communities as the security of water, energy and food becomes a very high concern  
13 due to future uncertainties. Studies pertaining to calculations of flows and  
14 dependencies between different resources, assessments of technology and policy  
15 applications, and quantifications of system performance have been conducted to  
16 understand their interlinkages and develop management options. This paper provides  
17 a state-of-the-art review on the concepts, research questions and methodologies in the  
18 field of water-energy-food. First, two types of nexus definition are compared and  
19 discussed to understand the nature of nexus research issues. Then, nexus research  
20 questions are summarized into three themes: internal relationship analysis, external  
21 impact analysis, and nexus system evaluation. Eight nexus modelling approaches are  
22 discussed in terms of their advantages, disadvantages and applications, and guidance  
23 is provided on the selection of an appropriate modelling approach. Finally, future  
24 research challenges are identified, including system boundary, data uncertainty and  
25 modelling, underlying mechanism of nexus issues and system performance evaluation.  
26 This review helps bring research efforts together to address the challenging questions  
27 in the nexus research and develop sustainable and resilient water, energy and food  
28 systems.

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