Transitional foresight: MLP as the theoretical underpinning of CLA: the case of the water sector of Iran

Tahereh Miremadi

Abstract

Purpose – *The paper aims to complement the six pillars analysis with the multi-level perspective to make it more systematic and policy relevant.*

Design/methodology/approach – *Take the innovation system foresight as the exemplar; the paper asks if the other systemic approaches to innovation can function as the middle range theory and underpin critical future studies. To answer, the paper combines the six-pillar approach (SPA) with the multilevel perspective (MLP) and builds "transitional foresight". Then it takes the fourth pillar; transitional causal layered analysis and applies it to a case study: water stress in Iran. The paper concludes noting that in transitional foresight, the borderlines, the players and the orientations of the foresight are clearer than the six-pillar analysis.*

Findings – *The SPA and MLP-integrated framework make a powerful research instrument for transitional foresight.*

Research limitations/implications – *The paper applied the integrated framework to a case "water system in Iran". But the framework should be applied in different cases in different countries to test its applicability.*

Practical implications – *The suggested framework can be used as a heuristics for the students and researchers who want to engage with the emancipatory perspective of the six-pillar approach and need to have an academic methodology with rigor and granularity.*

Originality/value – *The six-pillar approach of Sohail Inayatullah and the multilevel perspective of Geels can combine to make a powerful heuristic for transitional foresight.*

Keywords *Innovation, Culture, Sustainable development, Environmental politics, Forecasting*

Paper type *Research paper*

Tahereh Miremadi is based at Iranian Research Organization for Science and Technology, Tehran, Iran.

1. Introduction: systemic turn of foresight

There has always been a gap between the theory and practice of foresight. In recent years, the practice of foresight has sought to integrate with some theoretical approaches. Disappointed with the practical effect of Critical Future Studies (CFS) (Hideg, 2007), it tended to make a connection with the innovation system approach (Andersen, 2014). Innovation system improvises the societal process of consensus building that the foresight practice adheres to. In exchange, foresight helps to wire and orient the innovation system into the future (Martin, 1999).

These mutual endeavors are parts of the process which has, since then, been called the systemic turn of the Foresight [practice] which has gained momentum in recent years (Schlaile, 2017; Pirainen *et al.*, 2017; Dufva, 2015; Andersen, 2017; Pirainen and Gonzales, 2015; Weber, 2012; Wiener, 2020).

Among the authors behind this turn are Andersen and Andersen who embedded foresight practice in the theoretical framework of the technological innovation system (Andersen, 2014).

Received 30 April 2020
Revised 16 October 2020
4 December 2020
Accepted 19 December 2020

Monitoring the gradual changes of the resource, nature, and societal participation and complexity of foresight practice over time which has been aligned, albeit with a time lag, with the evolution of modes of innovation (Rothwell, 1992) and innovation policy paradigm (Lundvall and Borrás, 2005), they inferred that firstly, the driver of this co-evolutionary process is the changes of the collective understanding on what the "innovation" is. Second, the concept of "Five Consecutive Generations of Foresight" is born as the result of this co-evolution. This concept conveys a staged and gradual proliferation of the subject of Foresight, starting from the older form of foresight (science foresight) to more complicated ones. In the third stage "Innovation System Foresight (ISF)", foresight practice covers innovation system as its subject. The last two generations were not the subject of much explanation.

For ISF, the innovation system approach serves as the theoretical underpinning to delimit the area of interest, selection of participants, criteria of mapping the present conditions in the phase of foresight planning and beyond (Poonjan, 2020; Andersen and Pirainen, 2016).

The idea of ISF has been warmly welcomed by the epistemic community and applied to several cases. However, one cannot miss that the boundaries separating the last three generations apart are blurred and confusing. The authors acknowledged this murkiness while admitting "they did not recognize radical differences among the last three generations" (Andersen and Andersen, 2014), and by doing so, they unintentionally, undermined the theory of the "generations of foresight".

This paper concurs with the argument that there are many theoretical advantages and practical benefits by underpinning the foundation of foresight by the different approaches of the innovation system. Yet, it deviates from the ISF theory on multiple grounds to clarify the confusion around the shaky premises of five generations of ISF. To explicate its argument, first, the paper raises three questions and offers three presumptions as to the potential backing explanation:

Q1. Is there any other basis to distinguish categories of systemic foresight?

Andersen & Andersen have used the concept of five modes of innovation to build five generations of foresight (Andersen, 2014). Providing the blurring borderlines in this type of classification, the paper seeks to find another theoretical basis to have clearer classification.

Q2. Does the approach of the innovation system give the ultimate systemic understanding of innovation?

There are other strands of innovation studies with a different epistemological background that present a systemic approach to innovation (Coenen, 2008). One would wonder if these schools can serve as the theoretical underpinning of the foresight?

Q3. The last question is if Causal Layered Analysis (CLA) as an alternative to the mainstream of Foresight can take advantage of the theoretical underpinning of one of different systemic approaches to innovation?

CLA as a strand of critical future studies (CFS) has drawn the attention of academics and policy designers, yet, as Inayatullah has acknowledged CLA could, "lead to a paralysis of action, i.e. too much time spent on problematizing and not enough on designing new policy actions" (Inayatullah, 2009). Consequently, it is "best used in the conjunction with other methods" (Inayatullah, 2009). One would wonder if CLA can use the support of a middle-range theory carrying a systemic innovation approach, especially when it has the ambition to "be useful in developing more effective – deeper, inclusive, the longer-term – policy" (Inayatullah, 2004).

After this introduction, the paper continues with searching for the answers to these three questions. In the next part, it presents its theoretical argument which is just a tentative attempt to develop a transitional Foresight with the concern of sustainability. Then the Inayatullah's causal layered analysis (CLA) is introduced and the question as to why it

needs a theoretical underpinning, in the first place, is addressed. Then, it discusses the multilevel perspective (MLP) and explains how it can support CLA to develop more palpable and policy-relevant results. The paper proceeds to study the case of the challenge of water access in Iran. Through this case study, the theoretical merits of the concept of transitional foresight and its practical benefit will be examined.

2. The theoretical point of departure

The idea of foresight generations emerges when the academics see before them growing diversity of disciplines, rationales, paradigms, designs, methodologies and approaches, making it jungle-like full of extremely diverse animals (Andersen and Andersen, 2014). The objective of setting the generations apart is to showcase the process of foresight practice as a staged and evolutionary process. Any attempt to draw a bold line between the different stages serves to enrich the relationship between theory and practice of foresight and makes it a more convincing argument for how implementation should be carried out/ensured.

The merits of the ISF are acknowledged in the same vein. However, there are some no trivial inconsistencies within this theory that put at risk its theoretical integrity and coherency.

First: Although ISF maintains it is based on the evolutionary trajectory of "innovation" from unilinear to systemic, it stops short of extending the evolutionary process beyond the innovation system approach and contradicts the principle that the concept of evolutionary economics is also evolvable (Hodgson, 1995). By doing so, it implicitly accepts a teleological status for "innovation system approach", and denies the stylized fact that evolution is an open-ended process.

Second: The paper argues, innovation theory continues to evolve in recent years, and it has undergone a new paradigm shift (Steinmueller, 2018), which brought forth a new rationale to innovation policy. This new rationale provides legitimacy to mission-oriented innovation policy which gives a mandate to policymakers to design policies for mitigating grand challenges with environmental and social nature (Kuhlman, 2018).

Third: The paper argues that the branch of CFS, once coupled with the theoretical framework of a middle-range theory such as transition studies, can enhance its potential to be more policy-relevant. This coupling creates a new strand of foresight, dubbed "transitional foresight". In brief, the transition theory (Steinmueller, 2018) has the theoretical capacity to play the same role and more for the critical future studies as Andersens' presume the innovation system approach play for the third generation of foresight practice.

There are very few papers that have shed light on the commonalities of MLP and CFS from different angles including Papachristos (2018), Mäkelä (2020), Miremadi (2020), Vahekari Vähäkari (2020). Miremadi highlighted the role that CLA can play to extend the focus of MLP to the marginal people who otherwise are invisible and under the radar in the literature of sustainability transition. Vähäkari (2020) addressed the co-benefit of coupling MLP and CFS and focused on the scenarios and transitional pathways.

This paper, however, had a unique approach, focusing on the integration of MLP and CLA to have the former as the theoretical underpinning of the latter and exploring on its implications.

3. What is causal layered analysis and why it needs a theoretical underpinning?

While drawing heavily on the conceptualizations of his post-structuralist roots, namely, genealogy, distancing and de-construction, Inayatullah makes use of them as a methodological repertoire for action research. CLA defies the conventional definition of theory and/or methodology at the same time. It is a collection of philosophical conceptualization turned into a toolbox of methods, developed for praxis.

CLA has a complex structure carrying within different epistemological layers to deepen the understanding of the "present". Moving back and forth between the shallowest to the deepest layer, all at once, creates a new space of possible futures. CLA carries four types of analysis with four different epistemologies. The depth of analysis is sorted in ascending order. It starts with a litany which accounts for the official public or media description of an issue. Descriptions at the level of the litany focus on quantitative trends and problems. Explanations tend to be visible and obvious and issues are presented as unconnected, engendering feelings of helplessness and apathy. The litany is with zero analytic value, and then proceeds to systemic, discursive, and finally metaphor analysis. The litany is the layer that an official unquestioned view of reality is offered, which accounts for the official public or media description of an issue. Descriptions, in this layer, focus on quantitative trends and problems. Explanations tend to be visible and obvious, with no analytic value (Inayatullah, 2009; Inayatullah, 2004).

The second level is the social causation level with a systemic perspective. The data of the litany is explained and questioned in this layer. It is concerned with " systemic causes, including social, technological, economic, environmental, political and historical factors". It provides interpretation based on quantitative data, technical explanations and academic analysis. However, "while assumptions may be questioned, the paradigm within which a problem is framed remains unquestioned".

The third level is the level of analysis of discourse/worldview. The third level "is concerned with structure and the discourse/worldview that supports and legitimates it" Inayatullah (1998). As Inayatullah addresses: The task is to find deeper social, linguistic and cultural processes. Discerning deeper assumptions behind the issue is crucial here, as are efforts to re-vision the problem. At this stage, one can explore how different discourses [. . .] do more than cause or mediate the issue, but constitute it Inayatullah (2004).

At the fourth level, deep and unconsciously held ideological, worldview and discursive assumptions are unpacked. It focuses on 'the deep stories, the collective archetypes, the unconscious dimensions of the problem of the paradox' (Inayatullah, 1998). At this level: 'The language used is less specific, more concerned with evoking visual images, with touching the heart instead of reading the head' (Inayatullah, 2004). The intent is to draw out and deconstruct conventional metaphors, articulate. The intent is to draw out and deconstruct conventional metaphors, articulate alternative metaphors and bring the unconscious and the mythic to futures work.

The question which begs to ask is how these diverse layers of causality with different epistemological roots and different degree of depth and coverage, can relate to each other, hold together and open up the horizons to examine wicked policy challenges and develop careful and inclusive policy designs. The challenge is to mediate between the macro-level of the philosophical speculations and the micro-level of concrete policy problems which are addressed by the academic endeavors or anticipatory action research workshops.

The philosophical aspirations that CLA acquires from different sources have not helped it have conventional explanatory granularity and research rigor and it still needs an underlying theoretical framework or middle-range theory. The paper maintains that MLP is a likely candidate to serve as the theoretical underpinning of CLA, mediating between the macro-micro levels of CLA.

4. What is multilevel perspective and how it helps?

Transition studies are considered the new generation of systemic approach which opens to a broader and deeper understanding of innovation, as it calls for the changes of the backbone systems of modern societies; mobility, transport, food (Steinmueller, 2018). Geels maintains that MLP as a middle range theory is about scope. Geels (2007) MLP can be viewed as a system model of how the interaction between three analytical levels can

influence a transitional process of a socio-technical system. Depicted as a nested hierarchy, the meso-level of S &T regime accounts for the stability of existing technological development, the macro-level of the landscape consists of slow-changing external factors that impact and influence the socio-technical regime and the micro-level of niches accounts for the generation and development of radical innovations (Geels, 2002).

MLP typically portrays a chosen topic, historical development or action, and the elements and interactions that are linked to it. It aims to conceptualize and explain processes where multiple configurations of actors, resources, institutions and rules in different contexts create stability, as well as windows of opportunity for change (Noora Vaḧ Akari, 2020).

Socio-technical systems do not function autonomously. But they are the outcome of human activities. Humans are embedded in social groups, e.g. firms and industries, users, societal groups, public authorities and research institutes (Geels, 2020). These groups are divided into producer and user sides (Geels, 2004).

The capacity to act of the players can be related to many different characteristics or properties (e.g. routines, capabilities, resources, positions, interpretations, goals, interests, templates). They act not as atomic entities but as (macro) collectivities such as organized groups, organizations and nations (Geels, 2020).

These collective entities interact by generating, supporting or opposing different discourses, and by doing so, they legitimize or delegitimize different forms of actions or innovations " within some socially constructed system of norms, values, beliefs, and definitions" (Geels and Verhees, 2011). Actors try to confer legitimacy to their actions and/or innovations by linking their discourses to broad but diffuse and broad cognitive institutions (ideologies, generalized belief systems, societal discourses), normative institutions (values, role expectations, standards of acceptability), and regulatory institutions (laws, regulations) which Geels and his co-author call it ideograph (Geels and Verhees, 2011).

The paper presumption is that once CLA is supported by the middle-ranged theory of MLP, it clarifies the scope of the study in terms of delineation of the boundaries of the system and identification of the stakeholders and their participation and discursive interactions. Another implication of such coupling is to clear the range of probable and contested future (direction of the foresight.

Consequently, MLP elements facilitate, first, sorting out the epistemologically different layers of the reality, and second, more importantly, MLP as the whole, implies how all the layers to relate together.

In summary, compared to the original framework of CLA, the paper argument is that the integration with MLP enables the CLA to be more focused on policy relevance and conceptual language and clarity as it acquires a clear system delineation, transitional direction, present mapping and system scope and dynamics. The paper calls this framework "Transitional Foresight".

5. Building transitional foresight framework

The rationale behind the theoretical integration of the MLP and the CLA is their common and at the same time, their distinct traits: Geels analyses the past to understand the present and Inayatullah de-constructs the present to discover the possible futures. Geels's ex-post approach impedes speculative reasoning. In an opposite direction, Inayatullah's framework is prone to speculate and create multiple futures with different plausibility and favorability.

While having a very robust philosophical background, Inayatullah's way of thinking tends to offer different schematic methods and tools for praxis (Inayatullah, 1998). Geels, on the other hand, focuses on historical methodology. He tends to be less philosophical and technical, yet more attentive to social theories and theoretical works. Geels' works contain

very detailed historical events and a strong background on modernization theory. The sustainability transition literature stems from the concept of risk society and modernization II, the concepts, associated with advanced Western society (Giddens, 1991; Beck, 1992). The CLA and critical future studies seek to understand and learn the dynamics of different civilizations and different cultures around the world (Inayatullah, 2001; Inayatullah, 1992).

Coupling between CLA and MLP to build transitional foresight can have different steps. In each step, CLA borrows a specific element of MLP and use it in a specific layer.

Table 1 exhibits how different elements of the MLP can invigorate the granularity of CLA and make the MLP, the CLA's theoretical underpinning.

Consequently, an MLP could support CLA's four-layer. In the first layer, litany, the socio-technical system approach helps to define the challenge or wicked problem of public policy, normally in the quantitative form circulated in the mass media, without any analytical explanation. It offers an official recount of public policy problem or what is called "collective puzzlement on society's behalf." (John Grin and Anne Loeber, 2007). In the second layer, the systemic view; MLP's socio-technical system facilitates the system delineation by drawing system borderlines, separating it from its environment. It also could lead to the system differentiation into the three levels based on their structuration and separates the levels of landscape, regime and niches. And that sheds light on the dynamics created by the impacts of the landscape on the other two levels and the interactions between the regime and the niches.

Moreover, the information on the regime players consisting of market players, civil society and the State conveys the relevant contradicting discourses which guide the researcher to the third level and can be helpful when analyzing the dynamism of pro-stability and pro-change arguments from the point of social order.

That comes down again to the fourth layer. Actors try to confer legitimacy to their actions and/or innovations by linking their discourses to diffuse and broad cognitive institutions (ideologies, generalized belief systems, societal discourses), normative institutions (values, role expectations, standards of acceptability) and regulatory institutions (laws, regulations) which Geels calls it ideograph.

To elucidate how MLP can theoretically buttress CLA, the most fruitful way seems to apply the conceptual model illustrated in Table 1 on the specific case, as sustainability transitions and future studies are both context-bound, multifaceted, problem-oriented fields that often showcase their capacities while being operationalized through concrete cases.

Through a case study, the paper shows how MLP – both as parts and the whole – can theoretically strengthen CLA according to the framework of Transitional Foresight presented in Table 1.

Table 1 The layers of transitional foresight

Rank	*CLA's layers*	*The MLP"s parts that can help the CLA*	*Scope*
1	Litany (official and uncontested problem statement)	Regime (official narrative)	The initial Problem statement
2	Systemic analysis	The structural mapping; the players, the patchwork of policies	present mapping: system delineation and stakeholders' identification
3	Discursive analysis	The institutional logics of power blocks and discourses of resistance	Analysis of the resistance against or legitimacy of change
4	Metaphor analysis	The cultural meaning (ideograph)	Determine the direction of socio-technical change, make space for an alternative future

6. Case study: Iran water stress transition foresight

6.1 The landscape of Iran water stress

Iran is located in West Asia and borders the Caspian Sea in the north, and the Persian Gulf and Sea of Oman in the south. The country ranks the second-largest country in the Middle East (after Saudi Arabia) and the 18th largest country in the world with an area of 1,648,195 km^2 (Madani, 2016). Iran is a country with diverse topography. Its lowest point is on the southern coast of the Caspian Sea (28 m below sea level) and the highest point is Mount Damavand (5671 m above sea level), which is not very far from the Caspian Sea coast. While the Lut Desert at 56 m altitudes is the lowest internal point. Generally, Iran is a mountainous land consisting of more than half of the mountains, one-fourth being plains and deserts, and less than one-fourth constituting arable land.

This country enjoys a high climatic diversity. Temperatures can vary considerably throughout the country and during the different months of the year from −20°C to + 50°C, the country and during the different months of the year (Salehi *et al.*, 2020). The monthly average temperature in January is between −6°C and 21°C and in July is in the range of 19°C–39°C, which is, respectively, the coldest and the warmest months in most cities of the country. The very hot and dry climate of the interior areas changes suddenly to the wet and moderate coastal climates of the Caspian coastal areas to the north of the Alborz mountains. The cold climates of Zagros are replaced by the warm desert climates to the east (Ghobadian, 2015).

Iran receives 6.7 km^3/year of surface water from Afghanistan through the Helmand River. The flow of the Aras River, at the border with Azerbaijan, is estimated at 4.63 km^3/year. The surface runoff to the sea and other countries is estimated at 55.9 km^3/year.

The main water resource of the country is annual precipitation with 413 billion cubic meters (bcm). The mean annual precipitation in Iran is about 242 mm, less than one-third of the annual 860-mm precipitation in the world. Besides, Iran suffers from one of the highest rates of direct evaporation of this precipitation, which is 79 mm (71%) (Salehi *et al.*, 2020).

The geographical distribution of the rainfall varies considerably across the country, ranging from less than 50 mm in central parts to about 1000 mm on the Caspian coast. Most of the country receives less than 100 mm of precipitation per year. The average precipitation is about 250 mm/year. About 30% of the total precipitation of the country is in the form of snow, and the rest is rain and other forms of precipitation (Salehi *et al.*, 2020).

The total renewable freshwater and water supplies from consumption in the country are estimated at 130 and 29 bcm/year, respectively. The annual renewable water per capita of the country was decreased from 7000 m^3 in 1956 to 2000 m^3 in 1996 and is currently estimated to be less than 1700 m^3, quite below the global level (7000 m^3) and slightly above the MENA (Middle-East and North Africa) level (1300 m^3). It is expected that this value will be reached to the amount of 800 m^3 by 2021, which is quite less than the water crisis threshold of 1000 m^3 (Madani, 2016).

To store water in reservoirs, several dams are built in Iran to the extent that the country ranks third in the world. Currently, 316 small to large dams are providing a storage capacity of 50 bcm in 2020 (Fereshtehpour, 2020). The policy of excessive dam building caused severe social and environmental negative impacts (Yazdandoost, 2020).

Water pumping is another technology that has been used extensively throughout the country. Since the 1960s, there has been a steady increase in the number of irrigation wells and the quantity of water pumped, which has led to a declining level of groundwater in many aquifers across the country. The impacts are multiple:

- a decrease in good yields;
- an increase in the intrusion of saline water into aquifers;

- increases in land subsidence;
- an increase in pumping costs leading to agriculture becoming more costly;
- a decrease in the flow of groundwater into, through, and out of wetlands and rivers; and
- many other less direct but worrying consequences (Nabavi, 2018).

On the other hand, Iran is not among the group of countries with the highest installed desalination capacities. Therefore, growth will have to start from a relatively low installed base. The primary desalination projects in the country were implemented to develop the specified projects, which needed desalted water. While Iran's existing desalination plants use a mix of thermal and RO processes, the evidence shows that the future capacity will be mostly on RO (Nia, 2020).

Concerning wastewater treatment, evidence showed that before the Islamic revolution, wastewater treatment and reclamation were virtually inexistent in Iran. (Only the city of Isfahan and a small satellite and small systems had existed) A strong effort was made only after the 1990s (Tajrishy, 2010). In 2001, there were 39 wastewater treatment plants (WWTPs) with a total capacity of 712,000 m^3/day, treating the wastewater produced by a population of 3.8 million (Tajrishy, 2010).

Now, there are 240 treatment plants with a total capacity of around 11 million m^3/day covering more than 50% of the population in the urban areas. The new technologies like a ceramic membrane (Samaei, 2018) (Samaei, 2018) and nanotechnology for water treatment (Soleimanpour, 2011) are to be mentioned among others.

Currently, Iran is among the top groundwater miners in the world; thus, the groundwater situation is extremely critical in some parts of the country. Environmental Protection Agency estimates the speed of using groundwater resources in Iran, three times higher than the international standard. This excessive withdrawal causes the drying up of 297 of the 600 plains of Iran. Besides, the traditional sustainable groundwater withdrawal through qanats is no longer feasible (Yazdandoost, 2020). Environmental Protection Agency estimates the speed of using groundwater resources in Iran, three times higher than the international standard. This excessive withdrawal causes the drying up of 297 of the 600 plains of Iran.

The rapid decline of total renewable water resources per capita (from 2357 cubic meters in 1992, it declined to 1732 cubic meters in 2014) implies that there will be a crisis, soon. According to FAO (Aquastat, 2019), it is expected that this figure to decrease below 1000 cubic meters in 2030. The system is not relatively reliable. The Global Competitiveness Report, 2018 indicates that Iran achieved scores of 57% (ranking 85th globally) respectively on the "reliability of water supply" indicator measuring flow fluctuations and the lack of interruption (Dehnavi, 2019).

Climate change and higher temperature represent additional factors affecting water availability, but there are other pressures, such as economic sanctions, that have fueled agricultural self-sufficiency policies and caused a *de facto* water bankruptcy. Most parts of Iran have experienced a general dominant positive temperature trend, with the rate of change varying from 0.09°C to 0.38°C per decade during 1961–2010. While climatic changes and economic sanctions are commonly blamed as the main drivers of water problems, many argue that Iran is mainly suffering from a socio-economic drought (Madani, 2016).

Providing the population increase to 85 million, by the year 2021, the access to available water should be as large as 103 bcm. It means that agriculture application will exceed 95 bcm and drinking and industrial water to 8 bcm, respectively (Mohammadinezhad, 2020).

Moreover, irrigation networks are old and unreliable. Failing to audit and improve the water transmission networks, caused 35 bcm of water wasted in the transmission. According to Tehran University's Faculty of Environment report, until September 2015, 40% of the water

networks was worn out. Around 13% of the total water losses in Iran until this date was due to this exhaustion. Aryanfar (2020).

To be brief, Iran is one of the world's largest consumers of groundwater (Nabavi, 2018), and a vast majority of the population lives in areas that are highly dependent on groundwater for drinking and irrigation. Thus, a real crisis is developing beneath Iran's semi-arid land. Keep in mind that the water problem puts stress on food security, make people move from rural areas to the shanty towns around big cities, making the social anomalies skyrocketing and increases the social tensions between regions.

Continuing the business-as-usual approach in depleting aquifers will expose Iran to food and water risks as well as social and political security.

6.2 The litany: the issue of water access in Iran

In recent years, as water scarcity became more serious and its consequences more apparent, the challenge of water access has been one of the top issues in the minds of the Iranian people according to the successive annual report of the national poll of 2016 onwards (Ayandehban, 1397).The media's attention to this issue has increased and the issue of water scarcity and drought are the most highlighted vocabularies in headlines in the mainstream media (Khaniki and Mousavi, 2019).

The weather experts warn, with quantitative detailed reports, the risk of the drought was serious and that one day not a drop of water would remain. However, nobody offers a clear explanation on the nature of the water problems in society and while the need to tackling the problem of water access is collectively established, there is confusion about the role of the natural factor (climate change), the structure (State) and the agency (consumers) on creating the problem or how to mitigate the water access change challenge. It is just a pure blame game in which no party can suggest a definitive solution.

From MLP's vantage point, water access challenge *per se* is an appealing case of study, indicating that one of the backbone systems of the society cannot function without undergoing a radical change to a more sustainable system. Moreover, as the repetitive lines of reports on the subject indicate there is no inherent solution because each attempt to solve the problem will end up to a perhaps bigger problem, a wicked problem. MLP supports CLA to frame litany as an official recount of problem statement which needs to systemize, analyze, deconstruct and reconstruct in the following layers.

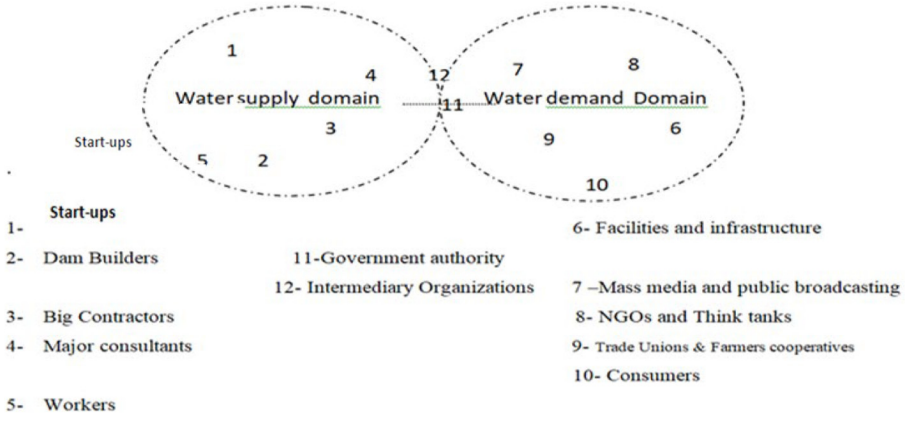
6.3 Systemic analysis

In the second layer, MLP offers its definition of a socio-technical system as the system boundary. According to this view, the water socio-technical system in Iran should be studied. As history witnesses, the current socio-technical regime of water in Iran emerged around 1960 under the guidance of the World Bank and the conditionality of foreign loans (Embry, 2003). The old landlord regime was based on the Qanat-Boneh structure. Qanat was a three-thousand old system of subterranean infrastructure, an indigenous technology that gave access to the hidden water at the foot of mountains. Boneh was a local communal arrangement to distribute water and resolve water disputes (Balali, 2009). Qanat-Boneh was a seamless socio-technical regime of water access in Iran that collapsed by the landscape pressure in the form of political interventions from the Westernized central government.

From 1960 onward, the newly established regime was a modernized irrigation infrastructure under the rationale of hydraulic mission which diffused the application of water pump and built major dams with the help of international investments and counselors and consolidated by the domestic technocrat-bureaucrats and private agro-industrial companies (Figure 1).

Then, in the post-Islamic revolution in the 1979 era, the hydraulic mission put a new face under the slogans of social justice, food security and agricultural independence. The

Figure 1 A modernized socio-technical system of water access



Source: By author, based on Geels (2004)

players, this time, are the central authority of the ministry of power, which increasingly concentrated the decision-making process in its control and formed a united front consisting of the local big contractors and counselors and inter-basin water canal builders and the companies of rural irrigation and urban distributors. They substituted the foreign companies and continue the policy of hydraulic mission with an even faster pace.

As the warming climate and drying natural resources revealed the un-sustainability of the hydraulic mission regime, the "budding technological and social niches" gained public attention. It is referred to as the technological niches hosting the small community of start-ups with emerging innovative technologies related to saline and brackish water and desalination and wastewater treatment. The desalination technologies and wastewater treatment sites are slowly increasing and civil society supports them. However, the system fails to open up to these technologies, while suffering from severe water stress.

Back to the layer of litany, there was confusion on who is to blame for the water crisis. In the second layer, once the systemic analysis is backed by MLP, this confusion is partly, cleared as it differentiates between the system players who resist the transition (the dam builders, technocrats and technical advisers) and the ones who push to actualize it (start-ups and civil society).

6.4 Discourse analysis

The third layer is the layer of discursive analysis and worldview. Like the second layer which questions the seemingly undisputed argumentation of litany, the third layer again examined the second layer's variables. From the second layer to the third layer, MLP redirects its attention from players to their values, arguments and discourses. Accordingly, there are at least two kinds of discourses, the incumbent players' discourse which de-legitimizes the radical change, and the discourse which tries to form a counter-hegemonic discourse. Geels and Verhees developed a perspective that conceptualizes the struggles for cultural legitimacy at regime and niche levels (Geels and Verhees, 2011).

In the case in point, hydraulic mission as the dominant discourse reproduces the soft parts of a socio-technical regime (Fuenfschilling, 2014) and is challenged by the different discourses of non-governmental social groups including frugal innovation start-ups and sustainability advocacy coalitions at the niches level. Moreover, there is the third discourse

that represents the interests of the firms and start-ups with high-tech treatment processes and advocates the market equilibrium and demand non-interventionist policies. They blame the water subsidies that makes any demand management policies inefficient as the main culprit of the present water crisis.

As a result of MLP's contribution, the third layer's analysis turns increasingly sociological. Discourses carry collective sense-making processes that represent the State, market and civil society values and principles. This triangle determines the dynamic of discursive struggle. It clarifies which is untold and hidden in the litany furthermore.

6.5 Fourth layer: metaphor

The last layer, metaphor, is the deepest layer of CLA. The Fourth Pillar of CLA is the place to disclose the hidden meaning of the metaphors. Myths and metaphors are so deeply embedded in everyday language that they become virtually invisible (Milojević, 2015). The interesting point, is the projection of the capability of the poststructuralist methods invoked in the fourth pillar to de-construct the old meaning, or rather metaphor, and reconstruct a new one and to derange and yet re-order anew.

However, Inayatullah's take of metaphor in the fourth layer is quite personal and aesthetic. He emphasizes "This level provides a gut/emotional level experience to the worldview under inquiry. The language used is less specific, more concerned with evoking visual images, with touching the heart instead of reading the head" (Inayatullah, 2020; Inayatullah, 1998).

MLP engages cultural meaning at three levels; landscape, regime and niche. Synonym to "Metaphor" MLP uses the term "ideograph". Nevertheless, the latter tends to convey the societal dimension of the meaning. It "guides behavior and belief into channels easily recognized by a community as acceptable and laudable" (Geels and Verhees, 2011). MLP assumes ideographs and cultural meanings co-evolve with technological change and patterns of consumption. Moreover, it tries to explain how the evolution of ideograph, technological acceptance and cultural legitimacy of the artifact depends on social struggles and argumentative discourse in the future. The detailed cases of car manufacturing in the USA (1830–1930), bath in the Netherland (1830–1950) and nuclear energy (1945–1986) in the Netherland (Geels, 2005a; Geels and Verhees, 2011; Geels, 2005b) are the cases that illustrated the dynamic transition from one socio-technical system to another is the product and the producer of the cultural meaning alternation of the artifact. This conceptual evolution has taken 60–70 years of social experimentations and learning either by collective dialogues and public debates in civil society or power struggles and social conflict and most often by both.

Therefore, MLP turns CLA's fourth layer a platform to observe outward signs of social phenomenon, social struggles and argumentation and acceptance.

Back to our case study, it suffices to know, the word "water" in Persian is associated with purity, cleanliness and fertility. According to the Quran, God has made everything from water. As Absar has pointed out the availability of water is indispensable for Muslims' hygiene routine and prayers' rituals (Absar, 2013). Absar also distinguishes the Muslim countries' water policies according to socio-economic and hydro-geological zones. This paper does not dispute these criteria but emphasizes the role that symbols and metaphors related to water, e.g. thirst, dessert and river, [. . .] play in the religious narratives especially Shiite Islam. For Iranian Shiite, "water" carries a political meaning, as the greatest bounty from God and the "deprivation of water access" stands for abolition of a religious right of Muslims. The political power that denies the access of water to his political rival or the insurgent group is called "Zalem" oppressor and "Zoolm" is equivalent to "oppression" and "cruelty".

To understand this special semantic relation, one has to understand the tragic narrative of Imam Hussein, martyred in theBattle of Karbala in 61 AH (680CE), and the significance of the fact that he was killed while being thirsty. The event occurred, in the hot summer and the place was near the River of Euphrates. The Imam character is beyond being just the grandson of the Prophet. Similar to Jesus in Christianity, he is the embodiment of sacrifice. Similar to Christians who drink wine as a symbol of the blood of Christ, the water is the symbol of the protest of Imam Hussein (Hassanzadeh, 2010).

It is believed that his martyrdom underpinned Shia Islam and helped God's religion to survive and prevail this tragedy is one of the most important religious narratives that the Shiite Iranians are born into (Farzaneh, 2007). It helps shape their identities and molds their interpretations of the right to natural resources especially water, martyrdom and justice (Husein, 2018).

The metaphor of the bloodshed and thirst associated with martyrdom and injustice is an essential part of religious visual arts and poetry and most importantly in the passion play of *Taa'zieh*. Every year, *Taazieh* drama pivoting around the narrative of the martyrdom of Imam Hussein recites the event of murdering the oppressed heroes when they were thirsty. Among the protagonists of the play is the character of *Hazzrat Abbas* who has a water skin on his shoulder and tries to carry water to the battlefront while being thirsty himself until he gets martyred.

Shiism as a dissident branch of Islam has ever since kept this narrative alive to fight against political oppression for centuries. In 1979, when the young Shiite revolutionary State finally assumed power, it claimed the metaphoric inheritance of the Karbala historic event and put it at the center of its water policy. Disowning the prerevolutionary water policy as a discriminative, non-inclusive one for the rich, it rode on the wave of religious populism, and played the politics of promises with cheap water for everyone nationwide, securing the allegiance of oppressed people for its domestic and foreign policy (Parsa, 2000).

Afterward, the rationale of the hydraulic mission was given new life by rival coalitions' power play. The parliament representatives scrambled to secure water for their constituencies by dams and water transfer canals. Sometimes, the water disputes among different provinces located in one main water basin broke into violence (Mesgaran, 2018.). Trying to fulfill the promises and recycle the petrodollars within the hands of big players, the State has established a complex irrigation utility system based on 600 huge dams and inter-water basin long canals from mountainous regions to the deserts (Iran, 2020).

What has not changed, though, was the religious backed claim to unlimited water in exchange for religious-national allegiance. The metaphor of thirsty equals oppressed was given new life by rival coalitions' power play. Water, indeed, is perhaps the resource most vulnerable to the tragedy of the commons. This tragedy is encouraged by State discourse and policies which pay subsidies for the price of electricity, water and agricultural food staples. Iran has one of the cheapest prices for water and energy in the world (Dehnavi, 2019). Therefore, there is no incentive for more efficient agriculture or recycling waste water in the urban and industrial infrastructures and other schemes for decreasing the water demand. The religious metaphor of water, reinvented to associate with distributive justice and agricultural independence, legitimizes the accelerating demand and undermines any policy to manage it.

The politics of promises of unlimited access to water, while extra-exploiting the water resources by modern technology, soon hit the hard reality of severe water stress. Once the lakes and rivers started to dry out and the climate change became visible, the State scrambled to design policies like managing the demand between the region and, as a result, social tension among the regions, dangerously, augmented. The metaphor of religious claim to water which once helped legitimize the revolutionary state came back to haunt it.

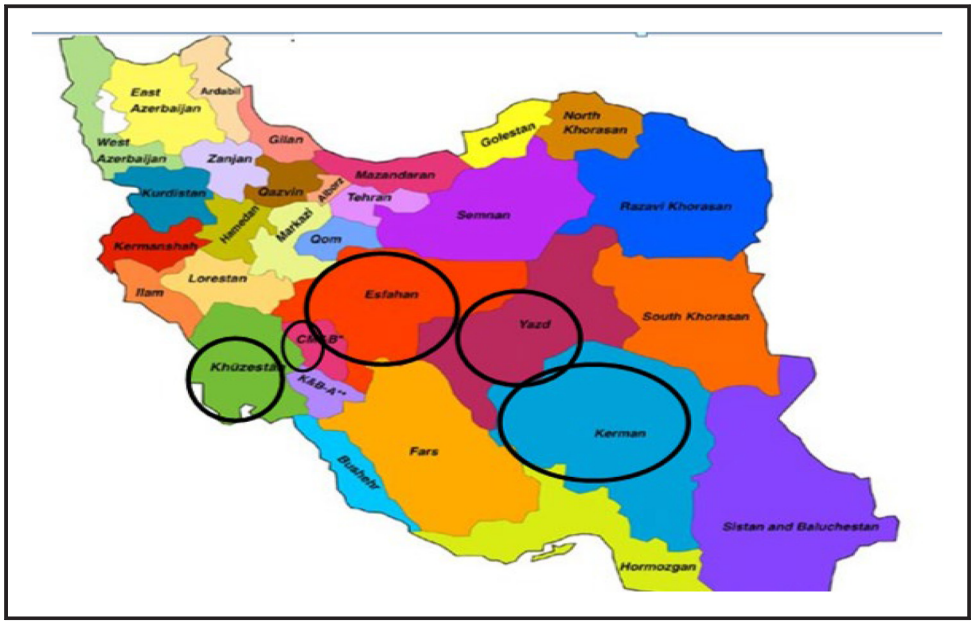
The people who fight for water share against local and central authorities use the same symbolism to claim their rights as the Iranian Islamic revolutionaries did to mobilize the people 40 years ago.

The association of metaphor of thirst and oppression is a very powerful and effective instrument used strategically by both the central government and its major contractor and those opposing its policy, often tainted with regional ethnic competitions. It takes a sequence of reciprocal cause and effect in which both fronts intensify and make the situation difficult for each other, leading inexorably to a worsening situation of the tragedy of commons.

Recently, the chain of events was temporarily put to rest when the State contractor (Khatam Headquarter) announced it had halted, despite the financial loss of $90m, All the four major canal projects designed to transfer the water among the five provinces of Khuzestan, Chahar Mahal & Bakhtiari, Esfahan, Yazd, Kerman, due to the mounting violent water disputes between these provinces (The Halt of Water Project of Behesht Abad, 1399) (Figure 2).

CLA underpinned by the MLP, transitional foresight, illustrates a more nuanced and complicated picture of the social metaphor or ideograph in the fourth layer than the original CLA. In this picture, the modern technologies (dams and electrical pumps) had substituted the old technology (Qanat irrigation system), and consequently, the way people perceive, value and use water, has been deeply affected. Urban water infrastructure allows people to take water for granted since they have 24 h access to clean and potable water seven days a week. The sheer size of dam reservoirs and the huge amount of water supplies seems to be endless and conceal the reality of the fact that Iran's challenge with water scarcity. Moreover, through the development of modern water distribution systems and as soon as the water starts flowing from a tap, this misperception develops that the user can comfortably assume that it flows from an endless supply. Other factors such as the increase of the population and awareness of the benefit of sanitation augment water consumption with an accelerating rate. All these factors translate to increasing demand and shortage of supply shortly. Despite these radical changes in the supply and demand, the symbol of

Figure 2 The geography of tensional regions over water access by the author



"water"" has still kept its cultural meaning intact. The culture is suspicious of any policy intervention to manage the water demand by the market rationale or the environmental concerns.

7. Discussion

This paper case study shows the implications of transitional foresight and how MLP supports the CLA in different ways, and to do so, it dissembled the three leveled structure of MLP and used the separate parts in the different layers of CLA: The problem statement in the first layer, the system borderlines and the major players' identification in the second layer, the institutional logics and rival discourses in the third layer and social metaphor in the fourth layer and the whole conceptual construct of MLP illustrates the inter-relationship among the parts and layers.

In the second layer, it helped delineate the borderlines of the socio-technical system and explained the differentiated participation of the players at two levels of the current regime and niches. In the third layer, the institutional logic of policy regime and the core values of advocacy coalitions were discussed as those arguments impact the power play in the second layer. And finally, in the fourth layer, the case showed the importance of co-evolution of technology and social meaning or ideograph.

The fact that the social meaning of metaphor "water" has not been evolved while the consumption pattern changed dramatically can indicate the reification of cultural institutions. The metaphor of "thirst" symbolizes the oppression and water symbolizes the right to protest in the political interpretation of the narrative of the fallen Imam. The metaphoric association of the fallen Imam and thirst was reified anachronically, despite the potential to create a new reflective meaning of human responsibility toward the environment in post-revolutionary Iran. And by doing that, the case study pinpoints the cultural-cognitive barrier (Lock-in) that impedes the society to differentiate the nature from the culture (Giddens, 1994) and take seriously the risk of human intervention to nature.

That defines the direction and what is the preferable future – raising awareness on the human responsibility toward nature. This part showcases the contributions of the different elements of MLP (system delineation, players' identification, discourses and cultural meaning to help CLA to have more scientific granularity. But the MLP as a whole does also contribute to enhancing the scientific rigor of CLA. The three levels of MLP are illustrative of what CLA describes a moving up and down layers. The researcher can have horizontal and vertical movements among producers and users' side and between regime and niches' levels. We can integrate analysis and synthesis, and horizontally we can integrate discourses, ways of knowing and worldviews, thereby increasing the richness of the analysis.

8. Conclusion

This paper starts with a description of the systemic turn of foresight practice. The idea of five consecutive generations of foresight describes the evolutionary process of foresight towards a systemic framework as a theoretical framework. Then, it underscored the confusion about the borders of the last three generations of foresight and raised three questions. First, it casted doubt on the appropriateness of the identifications of generations of foresight according to the mode of innovations, and second, the implications of integrating alternative systemic approaches to innovation and foresight.

To find the answers of the latter question, it chose MLP as the alternative systemic framework of innovation studies and CLA as the alternative strand of the foresight. The paper proceeded then to introduce the framework of transitional foresight as the systematic alternative of ISF. Based on the framework for transitional foresight, the case study of the

challenge of water access in Iran was analyzed. The case illustrated that transitional foresight has some improved features compared to the original CLA. It substantially improves the dimensions of the scope, the borderlines of the system and the participation of the players active in each layer, and the direction of the foresight. Besides, it is illustrative that all the four layers as the three levels of MLP are indispensable for what Inayatullah posits as the moving upward and downward of layers. Any other contributions need future research.

Finally, as to the first question, the paper suggests that there can be different generations of systemic foresight that stem from different epistemology and ontology backgrounds, such as CFS and IS. Finally, the paper concludes that there is no magic number for the generations of Foresight. As long as we have a systemic and open-ended approach to the concept of innovation and are attentive to the major paradigm shifts in the innovation policy frameworks, the co-evolution of foresight and innovation studies continues to be visible.

References

Absar, S.M. (2013), "The future of water resource management in the Muslim world", *Journal of Futures Studies*, Vol. 17 No. 3, pp. 1-20.

Andersen, A.A. (2014), "Innovation system foresight", *Technological Forecasting and Social Change*, Vol. 88, pp. 276-286.

Andersen, A.D. (2017), "Foresighting for inclusive development", *Technological Forecasting and Social Change*, Vol. 119, pp. 227-236.

Andersen, P.D. and Pirainen, K.A. (2016), "Cluster strategies for the North sea the offshore wind service sector", *A sectoral. Annual Conference of the EU-SPRI Forum*, The Technical University of Denmark, pp. 93-95.

AQUASTAT (2019), "FAO food and agriculture organization of the united nations. AQUASTAT – main database", FAO, Roma, available at: www.fao.org/aquastat/en/ (accessed 10 January 2019).

Aryanfar, Y. (2020), "A review on the water sector in Iran: current forecasts, scenario, and sustainability issues", *International Journal of Progressive Sciences and Technologies*, Vol. 22 No. 1, pp. 13-18.

Ayandehban (1397), "Iran in 1397, a foresight report; the report from of Ayandeh foresight institute", available at: www.ayandeban.ir/iran1397/ (accessed 12 January 2020).

Balali, M.R. (2009), "Reflexive management in the arid regions", *Environmental Values*, Vol. 18, pp. 91-112.

Beck, U. (1992), "Modern society, as a risk society", in Beck, U. (Ed.) *The Culture and Power of Knowledge: Inquiries into Contemporary*, Walter de Gruyter, Berlin, pp. 199-214.

Coenen, L.&. (2008), "Comparing systemic approaches to innovation for sustainability and competitiveness", *DIME International Conference ''Innovation, Sustainability and Policy*, University Montesquieu, DIME, *Bordeaux*.

Dehnavi, M.A.-S. (2019), "Comparative scorecard assessment of urban water", *Pricing Policies – the Case of Jordan and Iran. Water*, Vol. 11, p. 704.

Dufva, M. &. (2015), "Elements in the construction of future-orientation: a systems view of foresight", *Futures*, Vol. 73, pp. 112-125.

Embry, J. (2003), "Point four, Utah state university, and rural development in Iran, 1950-54", *Rural History*, Vol. 14 No. 1, pp. 99-111.

Farzaneh, M.M. (2007), "Shi'i ideology, Iranian secular nationalism and the Iran-Iraq war (1980–1988)", *Studies in Ethnicity and Nationalism*, Vol. 7 No. 1, pp. 86-103.

Fereshtehpour, M.S. (2020), "Evaluation of factors governing the use of floating solar system: a study on iran's important water infrastructures", available at: researchgate.net (accessed 9 May 2020).

Fuenfschilling, L. (2014), "The structuration of socio-technical regimes – conceptual foundations from institutional theor", *Research Policy*, Vol. 43 No. 4, pp. 772-791.

Geels, F.W. (2002), "Technological transitions as evolutionary reconfiguration, processes: a multi-level perspective and a case-study", *Research Policy*, Vol. 31 Nos 8/9, pp. 1257-1274.

Geels, F.W. (2004), "From sectoral systems of innovation to socio-technical systems: insights about dynamics and change from sociology and institutional theory", *Research Policy*, Vol. 33 Nos 6/7, pp. 897-920.

Geels, F.W. (2005a), "Co-evolution of technology and society: the transition in water supply and personal hygiene in The Netherlands (1850–1930) – a case study in multi-level perspective", *Technology in Society*, Vol. 27 No. 3, pp. 363-397.

Geels, F.W. (2005b), "The dynamics of transitions in socio-technical systems: a multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930)", *Technology Analysis & Strategic Management*, Vol. 17 No. 4, pp. 445-476.

Geels, F.W. (2007), "Feelings of discontent and the promise of middle range theory for STS: examples from technology dynamics", *Science, Technology, & Human Values*, Vol. 32 No. 6.

Geels, F.W. (2020), "Micro-foundations of the multi-level perspective on socio-technical transitions: developing a multi-dimensional model of agency through crossovers between social constructivism, evolutionary economics and neo-institutional theory", *Technological Forecasting and Social Change*, Vol. 152, p. 119894.

Geels, F.W. and Verhees, B. (2011), "Cultural legitimacy and framing struggles in innovation journeys: a cultural-performative perspective and a case study of Dutch nuclear energy (1945–1986)", *Technological Forecasting and Social Change*, Vol. 78 No. 6, pp. 910-930.

Ghobadian, S.G. (2015), "Solar desalination: a sustainable solution to water crisis in Iran", *Renewable and Sustainable Energy Reviews*, Vol. 48, pp. 571-584.

Giddens, A. (1991), *Modernity and Self-Identity: Self and Society in the Late Modern Age*, Stanford university press, Stanford.

Giddens, A. (1994), "Living in a post-traditional society", in Ulrich, B., Anthony, G. and Scott, L. (Eds), *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, Stanford University, Stanford.

Hassanzadeh, A. (2010), "The formation of non-state normative orders and the rituals pilgrimage", *International Journal of Interdisciplinary Social Sciences*, Vol. 5 No. 3.

Hideg, É. (2007), "Theory and practice in the field of foresight", *Foresight*, Vol. 9 No. 6, pp. 36-46.

Hodgson, G.M. (1995), "The evolution of evolutionary economics", *Scottish Journal of Political Economy*, Vol. 42 No. 4, pp. 469-488.

Husein, U.M. (2018), "A phenomenological study of Arbaeen foot pilgrimage in Iraq", *Tourism Management Perspectives*, Vol. 26, pp. 9-19.

Inayatullah, S. (1992), "Images of Pakistan's future", *Futures*, Vol. 24 No. 9, pp. 867-878.

Inayatullah, S. (1998), "Post structuralism as a method", *Futures*, Vol. 30 No. 8, pp. 815-829.

Inayatullah, S. (2001), *Understanding Sarkar: The Indian Episteme, Macrohistory and Transformative Knowledge*, Brill.

Inayatullah, S. (2004), "The causal layered analysis (CLA) reader", *Theory and Case Studies of an Integrative and Transformative Methodology*.

Inayatullah, S. (2009), "Causal layered analysis: an integrative and transformative theory and method", in Gordon, J.G. (Ed.), *Futures Research Methodology*, Millenium Project, Washington, DC, Vol. 3.

Inayatullah, S. (2020), "A castle surrounded by the wolves: towards a stage theory of the uses of the future", *World Futures Review*, Vol. 12 No. 1, pp. 1-15.

Iran, T. L. (2020), "Company of Iranian water resource management of Islamic Republic Of Iran", available at: http://daminfo.wrm.ir/fa/dam/stats (accessed 27 November 2020).

Khaniki, H. and Mousavi, S. (2019), "Representation of Iran's water issue in newspapers: content analysis of Iran, SharqDonyā-ye eghtesād and keyhān from 2012 to 2019", *Interdisciplinary Studies in the Humanities*, Vol. 11 No. 4, pp. 167-199.

Kuhlman, S. (2018), "Next-generation innovation policy and grand challenges", *Science and Public Policy S*, Vol. 45 No. 4, pp. 448-454.

Loeber, J.G. (2007), "Theories of policy learning, agency, structure and change", in Sidney, F.F. (Eds), *Handbook of Public Policy Analysis: Theory, Politics, and Methods*, CRC Press, New York, NY, p. 201.

Lundvall, B.Å. and Borrás, S. (2005), "Science, technology and innovation policy", *The Oxford Handbook of Innovation*, pp. 599-631.

Madani, A.A. (2016), "Iran's socio-economic drought: challenges of a Water-Bankrupt nation", *Iranian Studies*, Vol. 49 No. 6, pp. 997-1016.

Mäkelä, M.P. (2020), "Futures images of woodchips as an energy source in Finland", *Futures*, Vol. 121.

Martin, B.R. (1999), "Technology foresight for wiring up the national innovation system: experiences in Britain, Australia, and New Zealand", *Technological Forecasting and Social Change*, Vol. 60 No. 1, pp. 37-54.

Mesgaran, M.B. (2018), "A national adaptation plan for water scarcity in Iran", Working paper 6, Stanford Iran 2040 Project, Stanford University, Stanford.

Milojević, I. (2015), "Narrative foresight", *Futures*, Vol. 73, pp. 151-162.

Miremadi, T. (2020), "Coupling multilevel perspective and causal layered analysis", *Technological Forcasting and Social Change*, Vol. 155, p. 30.

Mohammadinezhad, S. (2020), "Modeling the internal processes of farmers' water conflicts in arid and semi-arid regions: extending the theory of planned behavior", *Journal of Hydrology*, Vol. 580, pp. 124-241.

Nabavi, E. (2018), "Failed policies, falling aquifers, unpacking groundwater overabstraction in Iran", *Water Alternatives*, Vol. 11 No. 3, pp. 699-724.

Nia, E. (2020), *Iran Integrated Water Resources Management*, T. Miremadi, Interviewer.

Noora Vaḧ Akari, V.L. (2020), "The future in sustainability transitions - Interlinkages between the multi-level perspective and futures studies", *Futures*.

Papachristos, G. (2018), "A mechanism based transition research methodology: bridging analytical approaches", *Futures*, Vol. 98, pp. 57-71.

Parsa, M. (2000), *States, Ideologies, and Social Revolutions: A Comparative Analysis of Iran*, Cambridge University Press, Nicaragua, Philippines, New York, NY.

Pirainen, K. and Gonzales (2015), "Theory of and within foresight – ", *What Does a Theory of Foresight Even Mean*, Vol. 96, pp. 191-201.

Pirainen, K. (2016), "Foresight and third mission of universities: the case for innovation system foresight", *foresight*, Vol. 18 No. 1, pp. 24-40.

Piirainen, K.A., Tanner, A.N. and Alkærsig, L. (2017), "Regional foresight and dynamics of smart specialization: a typology of regional diversification patterns", *Technological Forecasting and Social Change*, Vol. 115, pp. 289-300.

Poonjan, A.A. (2020), "Oresight for science and technology parks in a smart specialisation context", *ISPIM Conference*, The International Society for Professional Innovation Management (ISPIM), pp. 1-14.

Rothwell, R. (1992), "Developments towards the fifth generation model of innovation", *Technology Analysis & Strategic Management*, Vol. 4 No. 1, pp. 73-75.

Salehi, S., Dehghani, M., Mortazavi, S.M. and Singh, V.P. (2020), "Trend analysis and change point detection of seasonal and annual precipitation in Iran", *International Journal of Climatology*, Vol. 40 No. 1, pp. 308-323.

Samaei, S.M.-T. (2018), "The application of pressure-driven ceramic membrane technology for the treatment of industrial wastewaters–a review", *Separation and Purification Technology*, Vol. 200, pp. 198-220.

Schlaile, M.P. (2017), "Innovation systems for transformations towards sustainability? Taking the normative dimension seriously", *Sustainability*, Vol. 9 No. 12, p. 2253.

Soleimanpour, M.R. (2011), "Challenges in commercialization of nanotechnology in agriculture sector of Iran", *Annals of Biological Research*, Vol. 2 No. 4, pp. 68-75.

Steinmueller, J.S. (2018), "Three frames for innovation policy: R&D, systems of innovation and transformative change", *Research Policy*, Vol. 47 No. 9, pp. 1554-1567.

Tajrishy, M. (2010), *Wastewater Treatment and Reuse in Iran: Situation Analysis*, Sharif engineering university, Tehran.

The Halt of Water Project of Behesht Abad (1399), "Mehr news agency", available at: www.mehrnews.com/news/5069740/%D9%BE%D8%B1%D9%88%DA%98%D9%87-%D8%A7%D9%86%D8%AA%D9%82%D8%A7%D9%84-%D8%A2%D8%A8-%D8%A8%D9%87%D8%B4%D8%AA-%D8%A2%D8%A8%D8%A7%D8%AF-%D8%A8%D9%87-%D8%B9%D9%84%D8%AA-%D8%A7%D8%AE%D8%AA%D9%84%D8%A7%D9%81-%D8%A8%DB%8C%D9%8 (accessed 28 November 2020).

Vähäkari, N.L. (2020), "The future in sustainability transitions-Interlinkages between the multi-level perspective and futures studies", *Futures*, Vol. 123.

Weber, K.M. (2012), "Legitimizing research, technology and innovation policies for transformative change: combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework", *Research Policy*, Vol. 41 No. 6.

Wiener, L.S. (2020), "Aiming for a sustainable future: conceptualizing public open foresight", *Public Management Review*, Vol. 20 No. 1, pp. 82-107.

Yazdandoost, F. (2020), "Iran's water policy", *Water Policies in MENA Countries*, Springer, Cham, pp. 63-84.

Further reading

Aghaie, K.S. (2004), *The Martyrs of Karbala: Shi'i Symbols and Rituals in Modern*, Vol. 13, University of Washington, DC Press.

Beck, U.B. (2003), "The theory of reflexive modernization: problematic, hypotheses, and research program", *Theory, Culture & Society*, Vol. 20 No. 2, pp. 1-33.

Geels, F.W. (2010), "Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective", *Research Policy*, Vol. 39 No. 4, pp. 495-510.

Geels, F. (2011), "The multi-level perspective on sustainability transitions: responses to seven layers", *Environmental Innovation and Societal Transitions*, Vol. 1 No. 1, pp. 24-40.

Hammond, M. (2019), "Sustainability as a cultural transformation: the role of deliberative democracy", *Environmental Politics*, Vol. 29 No. 1, pp. 1-21, doi: 10.1080/09644016.2019.1684731.

Inayatullah, S. (2019), "Causal layered analysis a Four-Level approach to alternative futures", *Futurible Journal*.

Inayatullah, S. (2015), *What Works; Case Studies Studies in the Practice of Foresight*, University Press, TamsuiTamkang.

Tasnim (2020), "Khatam camp: we have stopped water transfer projects due to ethnical disputes among the regions the provinces", Tasnim News agency (in Persian), available at: https://www.tasnimnews.com/fa/news/1399/08/22/2387975/%D9%82%D8%B1%D8%A7%D8%B1%DA%AF%D8%A7%D9%87-%D8%AE%D8%A7%D8%AA%D9%85-%D9%BE%D8%B1%D9%88%DA%98%D9%87-%D9%87%D8%A7%DB%8C-%D8%A7%D9%86%D8%AA%D9%82%D8%A7%D9%84-%D8%A2%D8%A8-%D8%B1%D8%A7-%D8%A8%D9%87-%D8%B9% (accessed 27 November 2020).

United Nations (2015), "World population prospects, key finding and advance tables", available at: https://population.un.org/wpp/Publications/Files/Key_Findings_WPP_2015.pdf#:~:text=World%20Population%20Prospects%3A%20The%202015%20Revision%2C%20Key%20Findings,and%20distribution%20of%20the%20world%E2%80%99s%20population%20over%20the

Pirainen, K.A. (2017), "Regional foresight and dynamics of smart specialization: a typology of regional diversification patterns", *Technological Forecasting and Social Change*, Vol. 115, pp. 289-300.

Sarhadi, R.M. (2009), "Rainfall trends analysis of Iran in the last half of the twentieth century", *Journal of Geophysical Research*, Vol. 114, pp. 1-9.

Whitesides, G. (2019), "The Iranian point four program stretched through seven presidencies-Truman to carter-demonstrating how aid bolstering the long term relationship", *Science and American Foreign Relations since World War II*, Cambridge University Press, Cambridge.

Yuksel, N.C. (2017), "New foresight generation and framework of foresight", *PressAcademia Procedia*, Vol. 5 No. 1, pp. 224-233.

Corresponding author

Tahereh Miremadi can be contacted at: tamiremadi@yahoo.com