






Integrating the Sustainable Development Goals with the Water-Energy-Food Nexus: A Model for Agro-Industrial Companies

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Abstract. The Sustainable Development Goals (SDGs) express the ambition to achieve targets by 2030 for the Planet, as defined by the United Nations (UN). Under a similar perspective, the Water-Energy-Food (WEF) nexus approach highlights that these three elements are intrinsically interconnected. Consequently, they should be evaluated and managed in an integrated way. The agro-industrial sector makes extensive use of the most demanded natural resources, and plays a major role in both frameworks. Therefore, proposing an integrated view for this sector, dealing with both the UN SDGs and the WEF nexus is relevant and promising, but challenging. This short note provides a proposition on the connections between the SDGs and WEF nexus for the agro-industrial sector, based upon available literature. Finally, the overall expected benefits are to impact the decreasing of the water used volume (ensuring its availability, and quality), the energy efficiency-enhancing (stimulating the replacement by clean energy sources), and to avoid food wastage and contamination during the process.

Keywords: Agro-industrial · Sustainability · UN SDGs and WEF nexus

1 Introduction

Sustainability is becoming increasingly important and a major concern, due namely to the depletion of natural resources, as well as raising concerns regarding the disparity of wealth and lack of corporate social responsibility [1]. Policy makers, thus, must implement environmental policies able to support sustainable alternatives to the existing practices [2]. Having these concerns in mind, the General Assembly of the United Nations

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launched the 2030 Agenda with its Sustainable Development Goals (SDGs). This Agenda is a plan of action for people, planet and prosperity. It seeks to strengthen universal peace in larger freedom. Moreover, one of the main goals is to use the interlinkages and integrated nature of the SDGs. In response to increasing concerns about the long-term sustainability of human societies, the SDGs include 17 goals and 169 targets [3].

The SDGs provide an evidence-based framework for national, regional and global sustainable development planning and programming over a 15-year period, until 2030 [3]. Thus, countries need to take into account concerns about natural resources management and some of the SDGs major highlights are related with water, energy and food. Demand for these resources is increasing [4]. Their availability may indicate poverty decline and sustainable expansion [5]. Enhancing their security separately requires increasing efficiency. To reduce trade-off needs, one must also try to build synergies and improve public and private governance.

In 2011, the WEF nexus approach was incorporated into international discussions on sustainable development [6, 7]. According to [6], WEF nexus implies that water availability, energy and food security are inextricably linked. Consequently, actions in any one area have impacts in one or both of the others [5]. Focusing on the promotion of inseparable links between the use of resources to provide basic rights to food, water and energy security, there is a ‘nexus thinking’. This concept highlights the inseparable linkages between the use of resources and the universal human rights to water, energy, and food security [7].

Among the 17 SDGs, there are at least three specifically dedicated to this nexus approach: water security (SDG 6 – Ensure availability and sustainable management of water and sanitation for all); energy security (SDG 7 – Ensure access to affordable, reliable, sustainable and modern energy for all); food security (SDG 2- End Hunger, achieve food security and improve nutrition and promote sustainable agriculture) [3].

Some researchers proposed new models to address the relationships between SDGs for renewable energy [8], and natural resources [9], among others. However, not many attempts have been reported in connecting in more detail the SDGs and the WEF nexus. Therefore, the main aim of this short note is to integrate the Sustainable Development Goals with the Water-Energy-Food nexus, with a special focus regarding the agro-industrial sector.

1.1 The Agro-Industrial Sector

The agro-industrial sector is very energy intensive with important environmental impacts resulting from this sector and its companies. For reducing the GHG emissions in industrial sectors alternative energy (solar and wind energy for instance) and water resources (sustainable water production), should be employed here [10].

Water pollution owing to agro-industrial activities is a crucial problem to human beings and the ecosystem environment [11]. Approximately 85% of global water consumption is used for irrigation, and the demand is still increasing [12]. In order to avoid wastage, adequate water treatment and reuse through non-pollutant methodologies is suggested [13].

The Food scenario is not different. One out of nine people in the world go hungry every day according to The State of Food Insecurity section in the World Report [5].

Annually one third of food produced for human consumption is wasted on the food production chain [14]. Thus, it is a big challenge for all agro-industrial chains to produce food while avoiding food wastage.

1.2 Why Integrate WEF Nexus and SDGs for the Agro-Industrial Sector?

Due to the situation mentioned above, the literature about the WEF nexus expresses great ambitions to achieve policy coherence and overcome the unintended consequences of uncoordinated policies between different sectors [15]. Indeed, interdisciplinary research is essential for effective management of WEF nexus systems. While the various science disciplines have long histories of working independently in components of the WEF nexus, future research should integrate physical, agro ecological, and social sciences with economics [16], and the agro-industrial sector seems to be quite appropriate for testing and doing so. Nevertheless, different measures for overcoming issues related to the WEF nexus do vary by adopting diverse perspectives, which steer in different directions [15]. The majority of the matrixes available concerning WEF nexus perspectives do correspond to governmental, sectorial, cross national or national analysis [4, 6, 17, 18].

Additionally, at present, there is no universally recognized methodology for conducting nexus analysis [18], and few efforts have been made to integrate SDGs and the WEF nexus. The integration of other sustainable approaches is, therefore, recommended, namely with regards to the UN Sustainable Development Goals. Although there are some advances in the SDGs implementation, key gaps remain in terms of the assessment of interlinkages, trade-offs and synergies between targets [19].

Additionally, there is limited SDGs research about how exactly national interests, public expectations, technical and economic feasibility, and environmental performance can be accounted for at the country, local or company level [8]. Therefore, the integration between SDGs and WEF nexus can also be expected to lead to more sustainable actions in agro-industrial companies, and thus cover some of the gaps identified above.

2 Integration

Based on previous studies [20–22], a literature review was performed underscoring the synergies between the mentioned approaches (SDGs and the WEF nexus) with agro-industrial characteristics. Thus, the results were expressed in this article in the introduction text. Based on that, the selected criteria were first designated due to SDGs' list proposition [3].

The results are shown as follows:

- SGD 2 – End Hunger
 - 2.1 – End Hunger and ensure access by all people;
 - 2.2 – End all forms of malnutrition;
 - 2.3 – Double the agriculture productivity to provide more food production;
 - 2.4 – Ensure Sustainable Food production of small-scale food producers;
 - 2.5 – Maintain the genetic diversity of the fauna and flora;
 - 2.6 – Increase investment in rural infrastructure;
 - 2.7 – Adopt measures to ensure the proper functioning food.

- SDG 3 – Good health and well-being
 - 3.9 – Reduce the number of deaths and illnesses from pollution and contamination, including the ones coming from misuse of pesticides and fertilizers.
- SDG 6 – Clean water and Sanitization
 - 6.1 – Universal and equitable access to water for all;
 - 6.3 – Improve water quality;
 - 6.4 – Water-use efficiency across all sectors;
 - 6.5 – Implement integrated water resources management.
- SDG 7- Affordable and clean energy
 - 7.1 – Ensure universal access to energy services;
 - 7.3 – Double the rate of energy efficiency.
- SDG 8 – Decent work and economic growth
 - 8.2 – Higher levels of economic productivity;
 - 8.4 – Global resource efficiency in consumption and production.
- SDG 9 – Industry innovation and infrastructure
 - 9.2 – Promote inclusive and sustainable industrialization;
 - 9.4 – Upgrade sustainable infrastructure and retrofit industries.
- SDG 12 – Sustainable consumption and production
 - 12.1 – Implement framework of programs in Sustainable Consumption and Production;
 - 12.2 – Achieve the sustainable management and efficient use of natural resources;
 - 12.3 – Reduce Food losses;
 - 12.4 – Achieve the environmentally sound management;
 - 12.5 – Reduce waste generation;
 - 12.6 – Adopt sustainable practices.
- SDG 14 – Life below water
 - 14.4 – Regulate harvesting and end overfishing, an important substitute to wild harvesting.
- SDG 15 – Life on land
 - 15.1 – Ensure terrestrial and inland freshwater ecosystems;
 - 15.2 – Promote the implementation of sustainable management;
 - 15.3 – Restore degraded land and soil.

With this set of criteria, the aforementioned topics were classified under the three main topics, that correspond to the pillars of the WEF nexus: Water, Energy and Food. The results obtained indicate that the overall criteria correspond to the following percentages, by WEF domain: Water (23%); Energy (14%) and Food (63%). Then, at a more detailed level, topics were cascaded into WEF sub-topics. For Food, the sub-topics considered were: Food security and Improved Nutrition; Promote Sustainable Agro-industrial Sector; and Food Safety. For Water, we considered: Water security and safety; and Water resource efficient management. Finally, for Energy: Energy Security and efficiency; and Use of renewable energy.

In the end, criteria were allocated into these sub-topics, leading to the final correspondences between the SDGs and WEF nexus summarized in Table 1.

Table 1. Topic, Sub-topic and Criteria for the integration of SDGs with WEF nexus for agro-industrial companies.

WEF nexus Topic	WEF nexus Sub-Topic	SDGs Criteria
Food	Food Security and Improved Nutrition	Ensure access of food for all people
		Improve the food nutrition
	Promote Sustainable Agro-industrial sector	Increase small-scale food producers' productivity
		Sustainable Production
		Crop Diversity
		Increase investments in Infrastructure
		Build Measures to ensure the food sustainable Production
		Food Productivity
		Reduce Food Losses
		Sustainable Fishing Production
		Sustainable Forest
		Sustainable Land and soil use
	Food Safety	Reduce Food contamination
Achieve the environmentally sound management of chemicals and all wastes		
Water	Water security and safety	Water security
		Water safety
	Water resource efficient Management	Water-use efficiency
		Water resources management
	Sustainable Water Use	
Energy	Energy Security and efficiency	Energy Security
		Energy efficiency
	Use of Renewable Energy	Increase substantially the share of renewable energy

3 Discussion

As noticed, the SDGs and the WEF nexus must be integrated. Both of them aim to implement sustainable actions into different systems. However, it is a challenge to integrate both systems, that were built for reflection in a macro perspective (governments, regions, river basins, among others), and adapt them to a given specific more micro context, in this case, the agro-industrial sector and its companies.

The aforementioned sector has responsibility for the increasing damage found in the environmental systems, including water, energy and also food production. It may therefore benefit, the same also being the case for its companies, from aspects that were highlighted in this integrated view. This may include actions that ensure food security for the population and food sustainability important concerns, such as empowering small producers, reduce food losses or sustainable production. But may also refer to food safety actions (providing food free of contaminants). In the water perspective, it is inevitable to secure its availability, quality, and also appropriate management. Finally, regarding energy issues, an effort is made to point out the production control and efficiency, and the use of renewable sources.

In this context, case studies are suggested to validate the relationships found between the SDGs and the WEF nexus. Such case studies may cover a variety of agro-industrial companies, such as forests, fisheries, crop production, organizations that use soil, and even the use of chemicals. Subsequently, based on the selected items presented in this research, evaluation criteria should be proposed, such as the Linkert scale, a checklist, among other score methodologies. Given that, the agro-industrial production site should be inspected. Consequently, with the results, suggestions should be given on how to perform better in a sustainability vision. Thus, aspects for instance the use of renewable energy, water re-circulation, and the use of optimization tools can appear as the mentioned solution. Therefore, those aspects enable the proposed approach to target the challenge to enable information to the consumers on how the industrial transformation can be managed.

4 Conclusions

From the analysis conducted and presented here, one can conclude that:

It is possible to develop and propose integrations of the Sustainable Development Goals and the Water-energy-food nexus for agro-industrial companies, as was exemplified.

The suggested approach can be used by different agro-industrial companies in order to expand their sustainable actions and priorities in an integrated way.

As for possible additional work, the practical testing and implementation of such a framework in agro-industrial companies from different countries is suggested.

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