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The water-related impacts of FDI in the renewables sector: between growth and sustainable development in developing countries

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INDEX

RIASSUNTO

Gestire le risorse naturali in modo efficiente e sostenibile sta diventando sempre più un problema: cambiamenti globali come il riscaldamento globale, la crescita della popolazione, lo sviluppo demografico, le nuove tendenze nei consumi e l'intenso processo di urbanizzazione si presentano come un'incombente minaccia sulla disponibilità e la qualità delle risorse naturali. Non possiamo dunque fare a meno di riconoscere il carattere antropico della preoccupante condizione in cui versano le risorse naturali del pianeta. Stiamo infatti entrando in quella che viene definita come *Antropocene*, una nuova era geologica in cui l'azione dell'uomo è al centro di cambiamenti spesso irreversibili per la Terra.

L'attuale percorso di sviluppo e il cambiamento climatico stanno incrementando la competizione per le risorse naturali, la cui accessibilità risulta fondamentale per combattere la povertà. A livello globale, circa l'80% delle persone che vivono in estrema povertà si trovano in zone agresti, la maggior parte nei paesi in via di sviluppo. Le comunità rurali nel mondo affidano la loro sussistenza a pratiche agricole su piccola scala e ad usi della terra e delle risorse naturali che spesso sono regolati da tradizioni e costumi. Un accesso limitato ed iniquo al capitale naturale non fa che peggiorare situazioni di sfruttamento incontrollato delle risorse, spesso per ottenere profitti a breve termine, senza lungimiranza nel considerare le possibili conseguenze. Sembra dunque esserci una correlazione tra politiche volte a ridurre la povertà e una gestione sostenibile delle risorse. Ottemperare ad entrambi questi obiettivi richiede istituzioni forti; un quadro normativo più definito; ed una cooperazione tra diverse scale (locale, nazionale ed internazionale), in un'ottica di *governance*.

La risorsa acqua non fa eccezione al contesto generale appena introdotto. La crescente domanda, stimolata soprattutto dall'aumento demografico, contrasta con le sempre più frequenti narrazioni di "scarsità d'acqua". La disponibilità della risorsa presenta infatti livelli bassi o critici per ben 733 mila persone, circa il 10% della popolazione mondiale, e ad oggi sono circa 4 miliardi le persone che soffrono, almeno per un mese l'anno, di grave scarsità d'acqua.

Per determinare l'attuale stato della risorsa, è necessario indagare diversi ambiti legati all'acqua. Sarà questo l'obiettivo del primo capitolo del presente lavoro, che si concentrerà su aspetti quali la domanda, la disponibilità e la qualità della risorsa, analizzando poi il suo rapporto con due fattori critici per lo stress idrico: il cambiamento climatico e l'attuale processo di sviluppo.

La domanda d'acqua sta aumentando ad un ritmo costante dell'1% annuo, incremento dovuto soprattutto alla crescita demografica, allo sviluppo socioeconomico e ai cambiamenti di consumo. I maggiori prelievi d'acqua si riscontrano principalmente in cinque settori: agricoltura, energia, industria, insediamenti umani, ed ecosistemi. Il settore agricolo si classifica come il più esigente dal

punto di vista idrico, prelevando circa il 70% delle risorse d'acqua, seguito da industria (19%) e comuni (11%). Risulta comunque necessario sottolineare come queste statistiche cambino focalizzando la prospettiva alla scala nazionale o regionale. Il prelievo d'acqua è infatti legato al PIL del paese, cosicché, per esempio, ad un aumento del PIL pro-capite corrisponde una diminuzione dei prelievi per fini agricoli.

Il contesto presente vede due tendenze opporsi: non solo una domanda crescente, ma anche una disponibilità sempre più ristretta. Per comprendere il livello di stress a cui stiamo sottoponendo le risorse acquifere è sufficiente analizzare la disponibilità di acqua rinnovabile pro-capite. A livello globale, si assiste ad un declino del 20% negli ultimi 20 anni, ma regionalmente si rilevano picchi che arrivano fino al 30%, come in Nord Africa e in Asia Occidentale. Quando la disponibilità d'acqua è scarsa, alcuni paesi potrebbero trovare più proficuo importare i beni a maggiore esigenza d'acqua, piuttosto che produrli internamente. Si crea così un commercio di acqua virtuale, ossia basato non tanto sullo scambio diretto della risorsa, ma piuttosto alla quantità d'acqua contenuta in ciascun prodotto.

A determinare la disponibilità d'acqua non è solo la quantità fisicamente disponibile, ma anche la qualità. Le risorse idriche sono sempre più scarse e, in aggiunta, sempre più inquinate. L'80% dell'acqua di scarto prodotta da attività umane viene rilasciata nell'ambiente senza alcun trattamento. Soprattutto nei paesi meno sviluppati, la scarsa qualità dell'acqua risulta oggi una delle principali cause di mortalità infantile.

Il cambiamento climatico e lo sviluppo economico si presentano come causa e conseguenza della scarsità idrica. Il ruolo dell'acqua appare centrale nei processi di sviluppo. Una disponibilità limitata può rivelarsi una minaccia globale per la salute pubblica, la sicurezza alimentare ed energetica, la promozione e il mantenimento della pace e la crescita economica.

Riguardo la scarsità d'acqua, un dato in particolare sembra far riflettere. Le risorse disponibili sulla terra sarebbero infatti sufficienti per soddisfare la crescente domanda e lo stress idrico potrebbe essere piuttosto caratterizzato dalla mancanza di una gestione adeguata e dalla debolezza delle politiche di distribuzione dell'acqua. Risposte alla crisi idrica sono arrivate dalla comunità internazionale, attraverso diverse conferenze, aiuti economici, la promozione del diritto umano all'acqua e l'inclusione nell'Agenda 2030 per lo Sviluppo Sostenibile della tutela all'accesso all'acqua ed ai servizi igienico-sanitari (SDG 6). Nonostante ciò, i progressi nel settore risultano deboli, in particolare nei paesi in via di sviluppo. Le istituzioni locali possono svolgere in questo contesto un ruolo cruciale tanto nel promuovere, quanto nell'ostacolare, buone pratiche di gestione dell'acqua.

Questo appare chiaro nel contesto fortemente dibattuto degli investimenti diretti esteri verso economie emergenti, il focus del secondo capitolo. Queste forme di investimento sono principalmente rivolte a paesi in via di sviluppo, ma il ruolo che possono svolgere nel processo di crescita sostenibile dell'economia è controverso. Il capitolo si propone dunque di analizzare la letteratura rilevante per il dibattito, nonché le tendenze correnti nei flussi di investimenti diretti esteri verso i paesi in via di sviluppo e la loro relazione con gli obiettivi di sviluppo sostenibile proposti dall'Agenda 2030. Si rileva, in particolare, una tendenza interessante nel settore delle energie rinnovabili. Mentre per tutti gli altri settori il calo di investimenti è stato drastico a seguito della pandemia da Covid-19, il settore delle rinnovabili mostra un declino minimo. Nel 2021 le energie rinnovabili spodestano gas e petrolio, diventando così i maggiori riceventi di investimenti diretti esteri.

Il capitolo prosegue quindi analizzando gli effetti di questi investimenti sul settore acqua nei paesi meno sviluppati, concentrandosi in particolare sull'impatto del settore delle energie rinnovabili. Quando gli investimenti sono rivolti direttamente al settore dell'acqua, generalmente si ottengono in risposta un incremento dell'accesso e della qualità del servizio. Nonostante ciò, visto il carattere onnipresente dell'acqua nelle attività umane, sono molti i casi in cui, anche indirettamente, questo tipo di entrate finanziarie impattano negativamente sul settore acqua. Quando un potere economico forte prende il controllo o riesce a ridistribuire a proprio beneficio risorse d'acqua preziose per le comunità locali e per il mantenimento dell'ecosistema, si parla di pratiche di *water grabbing*. Anche il settore delle energie rinnovabili non appare esente da queste ptoblematiche. Nello specifico, verranno trattati due settori particolarmente esigenti dal punto di vista idrico: i biocombustibili e l'idroelettrico.

I biocarburanti rientrano nella categoria delle energie rinnovabili e sono associati ad un aumento della sicurezza energetica e della produttività agricola. Tuttavia, la produzione e trasformazione di biocarburanti sono legate a investimenti su larga scala sulla terra, spesso associati a fenomeni di *land* e *water grabbing*. La coltivazione intensiva di colture per biocarburanti, come la canna da zucchero, il mais e l'olio di palma, richiede ingenti quantità di acqua, che viene tolta ad utenti ed usi precedenti. Inoltre, attraverso i fertilizzanti e prodotti chimici, aumenta il rischio di inquinamento delle falde acquifere. Oltre alla coltivazione, anche il processo di trasformazione di queste colture in biocombustibili presenta un'elevata impronta idrica.

Analogamente, anche l'idroelettrico, supportato da narrazioni di sostenibilità e crescita economica, presenta degli aspetti controversi. Le problematiche in questo settore emergono sia dal punto di vista ambientale, che sociale. La perdita di biodiversità, la riduzione dello stock ittico, l'ostacolo al flusso dei sedimenti, lo spostamento forzato di intere comunità, sono solo alcuni esempi.

Molti progetti legati alla costruzione di grandi dighe sono inoltre collegati a violazioni dei diritti umani, nonché all'accrescimento di tensioni politiche e sociali.

Nonostante ciò, confermando quanto affermato precedentemente per la scarsità d'acqua, anche per gli investimenti diretti esteri il problema non sembrano tanto essere gli investimenti in sé, quanto piuttosto la debolezza delle istituzioni, che difficilmente gestiscono la risorsa (e la sua allocazione) in modo efficiente e sostenibile. Il terzo capitolo si propone di indagare più a fondo le principali attività che favoriscono un uso inefficiente della risorsa, nonché le carenze gestionali e politiche che possono insorgere nel settore acqua.

Diverse narrazioni, inclusa quella legata alla sostenibilità, diventano spesso un supporto fondamentale per le pratiche di accaparramento dell'acqua. Inoltre, il quadro normativo, sia nazionale che internazionale, non sembra essere chiaramente definito, lasciando delle vie di fuga che favoriscono queste operazioni. Anche il ruolo, sempre più centrale, delle multinazionali sembra essere di grande importanza. Questi attori, infatti, realizzata la centralità della risorsa, cercano sempre più di gestirne e controllarne l'accesso e l'allocazione, spesso a discapito di usi ed utenti precedenti. A determinare chi avrà accesso alla risorsa e in quale quantità rimangono comunque, nella maggior parte dei casi, le istituzioni. Anche quando, come accade in Cile, il settore è privatizzato, il ruolo delle istituzioni locali resta di centrale importanza per la gestione del servizio.

Il capitolo procede quindi con l'analisi dei fallimenti che è possibile riscontare nel mercato e nella gestione della risorsa acqua. Fallimenti del mercato emergono spesso nel caso di beni pubblici, ossia beni non escludibili e non rivali. In questi casi gli attori nel mercato possono agire con lo scopo di massimizzare i propri profitti, senza tener conto degli effetti su altri partecipanti. Altri difetti di mercato includono esternalità (ossia gli effetti di un'attività su altri attori, anche se non direttamente coinvolti nel mercato), monopoli e asimmetria informativa tra gli attori. Esempi di fallimento dello stato riguardano invece il comportamento dei burocrati, che potrebbero agire per soddisfare i propri interessi, piuttosto che quelli della popolazione, per esempio perseguendo il profitto o agendo in favore di soggetti che dovrebbe regolare.

Per una migliore gestione dell'acqua sarebbe dunque opportuno affrontare questi difetti, agendo per riformulare narrative; riconoscendo gli utilizzatori precedenti, adottando politiche a favore dei poveri; distribuendo la risorsa in modo più equo ed efficace; migliorando le infrastrutture; e adottando politiche di *governance*, che promuovano l'integrazione tra diverse scale (locale, nazionale ed internazionale).

Inoltre, soprattutto nel caso dell'acqua, appare fondamentale riconoscere l'interazione tra diversi settori. Il quarto capitolo si propone dunque di analizzare il nesso acqua-energia-cibo come possibile soluzione per una gestione più efficace e sostenibile della risorsa. Questo approccio consente di identificare le connessioni tra i tre settori, riconoscendo, per esempio, che un passo verso la sicurezza energetica potrebbe impattare negativamente sulla sicurezza alimentare ed idrica. Il caso del fiume Mekong, sul quale pendono un numero elevato di progetti idrici, presenta in modo chiaro questa interconnessione, nonché la necessità di integrare la gestione dei diversi settori. Il nesso acqua-energia-cibo potrebbe essere una soluzione, ma presenta comunque dei difetti. Ad esempio, sembra ancora avere scarsa considerazione di aspetti politici come la povertà e l'inuguaglianza, concetti chiave per l'idea di giustizia energetica, ed appare, per ora, un concetto ancora poco applicato nella realtà.

INTRODUCTION

The object of the present thesis will be that of assessing water management in the present context of growing scarcity of the resource, evaluating major flaws and possible responses. Water is a key factor in almost all activities of human life. As such, its management encompasses several sectors and actors. The present work focuses on renewable energy and the impacts of investments in this sector on water accessibility and affordability. The practices of *water grabbing* will be addressed to analyse water mismanagement and its primary drivers. The research revealed the need for a more integrated approach to water policies, supporting interactions not only between different sectors, but also across different scales (local, national, and international).

Water, a good of primary importance for life on Earth, is growing scarcer. Recent data on water availability present a concerning framework, with increasing rates of water scarcity, especially in developing countries. Since 1990s, the global per capita potable water availability declined from 9.000 m^3 to 7.800 m^3 in 2010s, and levels are expected to decrease even more in the near future (Bompan and Iannelli, 2018). However, water is not equally distributed across the planet. A fall in water per capita availability is evident both in developed and developing countries. Italy, for instance, reported a decline of about 600 m^3 in the last decades. This data, however, pales beside the decline experienced by Ruanda, where per capita water availability fell from 3114 m^3 to 837, or Syria, where it went from 1463 m^3 to about 300 m^3 (*ibid*). These decreasing levels of water availability are coupled with an increasing demand, generating a contrasting trend and a gap between demand and supply.

Sanitation is another challenge. About one billion people lack access to water services, with deleterious effects on health. Water-borne diseases are a plague which affects especially children and a major cause of infant mortality. The problem is enhanced under the current pandemics, which is making emerge evident gaps in access to water and sanitation for all, everywhere.

Water scarcity is a problem that affects mainly potable water, but it is increasingly relevant also for agriculture and industry. Consequently, the perceived risks from the business sector are making the possess and management of water resources more and more an object of desire for economic interests. Several interlinked drivers seem to favour water scarcity, including climate change, which intensifies drought risks and expands arid lands; poor management of infrastructures, which causes leakages and waste of precious freshwater resources; population growth; and changing lifestyles, which result in an increased trend towards the consumption of water-demanding goods. In this sense, water resources seem to suffer particularly from the ongoing process of globalization.

Water scarcity is raising concerns among world policymakers, as it can affect both quantity and quality of water. As might be expected, developing countries in arid regions are more severely

affected and experience water-related conflicts and social burdens, such as displacement. Yet, water availability is reported to be probably enough to comply with the rising demand. This means that the problem of water scarcity lies within the management of the resource and on how economic, social, and political pressures are being addressed, rather than on its physical lack. Therefore, institutions play a crucial role in the management of the resource, especially as regard its allocation. In developing countries, poor water policies are not only a burden for the water sector, but they also increase poverty rates. This is why good governance and strong institutions appear pivotal to address water scarcity and the impacts that it could have on other relevant economic sectors, including, for instance, food and energy.

The context just presented represents the frame in which the thesis is inserted. Starting from water scarcity issues, the work will proceed addressing a specific field: foreign direct investments in the renewable energy sector and their impacts on water resources in developing countries. The choice of addressing developing countries has been made assuming that people in wealthier economies do not experience water access constraints. Emerging economies increasingly see opportunities of economic growth in FDI and their reliance on this kind of flows appears significant. Indeed, FDI flows are mainly directed towards developing countries. Foreign direct investments flow towards developing countries will therefore be addressed with more attention. As regards the decision to focus on the renewables sector, this appears relevant in relation to current trends emerged from the research conducted on FDI flows. Remarkably, while all other sectors experienced a dramatic decline in FDI flows as an effect of the covid-19 pandemic, that of renewables showed resilience. The decline in this sector is much slighter than in any other field. This trend allowed for the sector to overtook gas and oil as the primary source of energy, in 2021.

The recent spur in the renewable energy sector is addressed by many as a positive sign of an economy which is finally dealing with climate change issues. Renewables are indeed perceived as a source of clean energy and as an alternative to fossil fuels. However, when adopting a water-centred lens, renewable energy projects waver in their economic, social, and environmental sustainability. Some renewable technologies, such as solar and wind do not exert high pressure on water resources and will thus be excluded from in-depth research. On the contrary, other renewables, including biofuels and hydropower, are water-intensive and present a significant water footprint. Controversial practices in these sectors have been defined as *water grabbing*, a concept referring to the act of powerful actors of controlling, deviating, and dispossessing water resources, subtracting it from previous users, often poor and marginalised people.

Therefore, the thesis will focus on the impacts of these large-scale projects on water resources and poverty. Growing bioenergy crops appears as a thirsty business. Sugarcane, palm oil, and jathorpa are just some examples of water demanding crops used to produce biofuels. Water demand in the sector is also driven by the process of transformation of these crops. What is more, the agri-business is responsible for high levels of water pollution from the use of pesticides and fertilisers, which degrade surface water and trickle through the land, polluting aquifers.

As regard hydropower, dams are being constructed all over the world, leaving us with few free-flowing rivers left. The importance of rivers in the economic, social, and environmental realm is frequently overlooked. Dams present several controversies, from environmental to social degradation. This happens mainly because these projects affect water flows on which humans, animals, and plant rely for their survival. Additionally, dams are frequently contested from the human-rights perspective, especially as regard the displacement of local population because of the creation of the artificial basin. In the Philippines, for instance, dam building caused the displacement of indigenous populations, threatening their culture and their traditions, beside their livelihoods. Dams are also particularly concerning because they affect both local and downstream populations.

Solutions are needed to better address the management of water resources, especially in an economically relevant sector as energy. The work will thus move to the political context in which the water sector is inserted, in order to better understand the factors easing *water grabbing* practices. Major narratives and drivers justifying the grabs will be presented, together with the main complexities which characterise the water political and economic domains. Market and government failures in the sector will thus be addressed to understand the main sectoral flaws favouring controversial practices.

Understanding the political context of water resource management appears important to identify political flaws, and thus outline possible solutions. These include reframing the water grabbing narratives; improvements in water allocation; pro-poor water policies design; international cooperation; better designed regulatory frameworks; stronger institutions; and water governance. In particular, as regard the energy sector, the literature seems to support the nexus approach as a way to efficiently and sustainably manage water resources. Water and energy are undoubtedly connected, but there is a third sector which appear entwined to water and energy: food. A sectoral strategy cannot address the several synergies existing among these three sectors. Biofuels, for instance, may be crucial in improving energy availability, but they may also increase competition for water and land resources between energy and food sectors. Likewise, hydropower may generate energy and increase water availability for irrigation, but may negatively impact local people (e.g., though displacements) and

water availability for downstream populations. Despite still presenting some flaws and in spite of national reluctance on its application, an integrated approach would probably positively impact the management of all the three resources, ultimately improving food, water, and energy security.

CHAPTER 1

GLOBAL WATER CRISIS: AN INTRODUCTION

There are about 1.400 million km^3 of water on our planet, of which 97% is saltwater, and only less than 3% is freshwater. Most freshwater is frozen in glaciers or deeply stored underground, in aquifers. This leaves us with only 0,003% of planet's water (about 45.000 km^3) available for basic human activities, such as drinking, hygiene, agriculture, and industry (FAO, 2017). Luckily, water is not a finite resource, and its amount is kept stable by the water cycle. Yet, human-driven problems, such as pollution, climate change, and resources depletion, are stressing the resource availability to the point that now we hear scholars talking about water scarcity and water crisis. Since 2010, the United Nations officially recognises access to water and sanitation as a human right and in 2015 the 2030 Agenda for Sustainable Development integrates water issues among its 17 goals to be achieved by 2030. Specifically, goal number six aims at ensuring availability and sustainable management of water and sanitation for all. However, there is still much to do to comply with this goal. Numbers speak clearly: billions of people still lack access to safe drinking water, sanitation and hygiene; 2.3 billion people live in water stressed countries; natural wetlands are rapidly shrinking, at trice the path of forest loss; 129 countries are not on track to comply with the goal by 2030, with a current rate of progress which should at least double to achieve it in time (UN, 2021). These data present a worrying situation. Improvements in access and management of water and sanitation services are fundamental to deal with both economic and social inequalities, to implement resilient actions against climate change, and to promote a sustainable development. The importance of goal number six's achievement becomes especially visible in the light of the current covid-19 pandemics, which urgently calls for an improvement in the policies which regulate access to clean water and sanitation, considered as the first step to answer the crisis.

The aim of this chapter is that of shedding light on the current state of global water resources by analysing water demand, water availability, water quality, the effects of the ongoing climate crisis on water resources, and the water-development nexus. The resulting framework presents water resources as increasingly constrained both by climate change, which is altering the water cycle, and by human activity, which is overexploiting and contaminating water resources. This is inevitably leading us to a global water crisis, with deleterious effects for human health, food and energy security, peace, economic growth, and the environment. Responses to a global crisis should come from the international community, which is already moving in this direction through the 2030 Agenda for Sustainable Development. However, the ultimate responsibility falls on national and local governments, which should be the leading figures in acting against water scarcity and water insecurity

but seem still not enough engaged and aware of the importance of water resources protection and good water management practices to achieve a sustainable and inclusive growth.

1.1. Water demand

Water use has relevantly increased in the last decades. According to the UN Report on World Water Development (2021a), water demand has sharply grown since the 1950s and, since the 1980s, it has steadily risen at 1% per year. Three major global drivers can explain this continuous increase in water demand: population growth, socio-economic development, and changing consumption patterns (UN, 2021a). The growing demand emerges not only as a way to satisfy basic needs of a growing population, but also, and above all, to keep up with society's standards of living.

This demand is not homogenous, as it varies across sectors and regions. An analysis of water withdrawals by sector reveals that, globally, agriculture holds the main share of water withdrawals (70%), followed by industry (19%) and municipalities (11%) (AQUASTAT, 2021). However, there are relevant variations in water demand by sectors when tightening the focus to a regional scale. The amount of water withdrew is strongly related to local characteristics, such as local climate and the relevance of agriculture for the economy. For instance, there is marked difference between European water withdrawals and African withdrawals: for the former, industry is the main user, while for the latter the major withdrawer is the agricultural sector (ibid). This divergence in the sources of demand emerges mainly from different structures in the economies. When relating the sources of withdrawals to the GDP of a country (figure 1.1), it appears that an increase in GDP corresponds to a decrease in withdrawals for agricultural purposes. This might be due both to higher incomes and a growth-enhancing structural change, which displaces labour from agriculture towards more productive sectors, such as manufacturing.

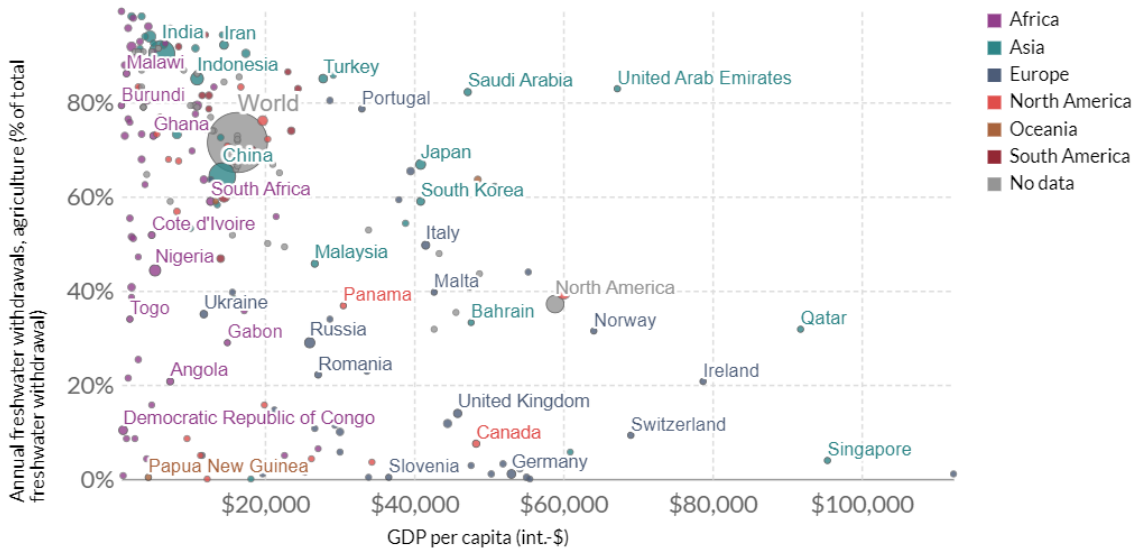


Figure 1.1: Agricultural water withdrawals vs. GDP per capita, 2017. Source: Our World in Data (2021).

Water demand also varies across regions, with fast-growing economies such as China and India ranking first for global water withdrawals (Statista, 2021). Unfortunately, there is a non-positive relationship between water availability and demand for water of a country, so that a significant water demand may be found in highly water stressed areas (Hoekstra and Hung, 2002).

Generally, sources of demand for water can be divided into five major categories: food and agriculture, energy, industry, human settlement, and ecosystems (WWAP, 2012).

1.1.1. Food and agriculture

We may have the impression that we could live with a small amount of water, but we tend to ignore that we eat more water than we drink. Every food requires a certain amount of water to be produced, meaning every food has a *water footprint*. For instance, we need 1 to 3 tonnes of water to grow 1kg of cereal, while 1kg of beef requires about 15 tonnes of water to be produced; on average, about 2.000 to 5.000 litres are needed to produce a human daily diet (FAO, 2017).

In relation to other sectors, agriculture has a significant water footprint; in fact, it accounts for the highest percentage of water withdrawals, mostly for food production, but also for energy (biofuels). As the more GDP grows, the more agriculture's share of total withdrawals per country shrinks (figure 1.1), the major source of water demand for agricultural purposes are developing and low-income countries.

Water consumption for agriculture is measured taking into consideration different uses, from food, fibre, and feed production to evaporation losses from the soil, reservoirs, and canals (WWAP, 2012). Irrigated agriculture plays a central role: even though representing 20% of the total cultivated land, it contributes to 40% of global food production and, yielding much more than rainfed agriculture, its importance will continue increasing (FAO, 2021a). Indeed, higher productivity appears fundamental to comply with the growing population and urbanization: forecasts indicate population will increase up to 9 billion by 2050 and agriculture will be of primary importance to guarantee food security (UN, 2015).

Beyond a growing demand, agriculture also needs to respond to changing consumption patterns. With income rising in many developing countries, diets are changing, with a tendency towards more caloric and complex food, which will require an expansion of agricultural production by 70% by 2050 (World Bank, 2020).

1.1.2. Energy

Water and energy have a complex relationship: energy is needed in order to supply and process water and water is needed in almost every step of energy-production processes.

Energy sources can be labelled *primary*, when they are extracted or cultivated, such as crude oil, natural gas, and biomass; or *secondary*, when they are transformed into petroleum products or electricity, thermal processes, hydropower, solar, and wind (WWAP, 2012). Primary energy accounts today for more than two-thirds of water use, with fossil fuels accounting for 40% and biofuels for 30% of the entire sector's water consumption (OECD/IEA, 2018). Indeed, the major sources of energy today are oil, coal, gas, and hydroelectric power, with fossil fuels still representing the dominant energy source, counting up to 80% of total energy consumption (Ritchie and Roser, 2020). A transition to low-carbon energy sources, especially solar and wind, which are far less water demanding than other, more used, sources, would significantly reduce the energy sector's demand for water.

Future projections predict energy and electricity consumption will grow, especially in developing countries. In the period 2007-2035 energy demand is expected to increase by 50%, with developing countries accounting for 84% of this growth (WWAP, 2012). Assuming no changes in consumption patterns, to comply with this rising demand, production will increase by 11.2% by 2050 and, consequently, water use from the energy sector will probably rise as well, negatively affecting especially already water-stressed areas, such as China, India, and the Middle East (ibid).

1.1.3. Industry

Demand of water from the industrial sector can derive from several needs, among which steam generation, washing and cooling of equipment, and dilution. Water demand from industry is low compared to other sectors: globally, it holds 19% of total water withdrawals (Ritchie and Roser, 2017). Opposite to the agricultural sector, water use for industry appears more intense in high-income countries: the United States, the primary user of industrial water, withdraws over 300 billion m^3 per year, followed by China, at 140 billion m^3 (ibid).

Beyond the quantity of water used, in the case of industry, the quality of water seems a relevant issue. Wastewater is usually discharged with negative impacts for the environment, especially at the local scale. Industries such as agro-processors, textile, and tanneries can pollute water resources and become a threat for both the environment and human health (WWAP, 2012). In the long run, water contamination, beyond reducing access to water for human consumption, can cause the alteration of water ecosystems, ultimately killing fishes on which many people rely for their daily sustenance.

1.1.4. Human settlements

Population is expected to grow up to 9 billion by 2050. Meanwhile, a global trend of rural-to-urban displacement is gaining strength. When coupled, these two tendencies create huge problems for urban settlements. Indeed, the growing population will probably concentrate in cities, as rural areas are progressively abandoned. The main problem is that population seems to be growing faster than the improvement in water and sanitation services, thus furtherly constraining marginal and disadvantaged groups into poverty conditions (WWAP, 2012). The hotspot of inequalities and degradation due to urban population growth are slums, which population accounts today for 30% of total urban population, a percentage which is expected to keep on growing (UN, 2015). In slums, it seems increasingly difficult to effectively provide adequate services, including responding to the rising needs for water, sanitation, and hygiene: since 2000, the number of urban population without access to safe drinking water has increased by 50% (UN-Water, 2021). In Mumbai, for instance, the water supply system is almost completely absent in slums, where 56% of the population lives (UNESCO/ARCEAU IdF, 2016).

What is more, urban areas are also a relevant source of water pollution, especially when coupled with industrial waste. This appears particularly true for cities in developing countries: Jakarta, for instance, with a population of 9 million people, produces about 1.3 million m^3 of sewerage, of which only the 3% is treated (WWAP, 2012).

1.1.5. Ecosystems

Ecosystems are of central importance because they determine water availability and water quality. When talking about ecosystems, we include forests, wetlands, and grasslands, which play a fundamental role in the global water cycle. Indeed, all freshwater relies on the good conditions of these ecosystems. Water demand from an ecosystem depends on the amount of water it needs to maintain or restore the services we want that ecosystem to supply (WWAP, 2012). Indeed, ecosystems can provide several benefits to people, including mitigation of the effects of draughts and floods and treatment of wastewater, ultimately providing usable water for drinking, industry, recreation, and wildlife habitat (UN-Water, 2021a).

Despite this, there seems to be an increasing competition between ecosystems maintenance and socio-economic sectors. Wetlands, for instance, have been severely affected by human activity and declined by 80% since the pre-industrial era; furthermore, 20% of aquifers is being over-exploited, causing the sinking of land and saltwater infiltrations, which threaten food and human security (UN-Water, 2021a).

However still not predominant, a tendency is emerging towards recognizing the benefits that ecosystems can provide to people. This includes acknowledging that water used to maintain ecosystem is also water used to support human needs, and, ultimately, a step towards sustainable development (ibid).

As regards the future of water demand, assuming a business-as-usual scenario, there will probably be a decline in water withdrawals from agriculture (which will nevertheless remain the main user), while withdrawals for domestic and, especially, industrial use will increase (UN, 2021a). Indeed, rising incomes and urbanization are pushing water demand from industry and energy, while changes in diets are increasing the use of water-demanding foods, such as meat. As a consequence, fast industrializing countries are a major cause of worry when elaborating future projections: in the case of China, for instance, the demand for water grew worryingly from 550 billion m^3 to 657 billion m^3 (Bompan and Iannelli, 2018).

1.2. Water availability

In order to sustainably manage water resources, withdrawals should not overcome the level of freshwater replenishment. However, the growing demand, which seems constantly rising, or at least

maintaining its current, elevated, standard, appears always more difficult to satisfy, leading to an overexploitation of the resource. Groundwater, on which 2.5 billion people rely for their basic needs and sustainment, is being over-exploited in 20% of world's aquifers (UN, 2015). This leads to an incompatible double tendency, which is putting water resources under stress: a shrinking level of water availability per capita coupled with a growing demand

Analysing the per capita level of internal renewable flows[1] appears an interesting way to understand the stress we are exerting on water. Following the large population growth, the level of renewable freshwater resources per capita is declining significantly in many regions of the world (figure 1.2), both in developed and in developing countries. The difference is striking between 1962 and 2017. In 1962, the renewable freshwater resources per capita in Brazil reached 73.986 m^3 and they declined up to 27.238 m^3 in 2017; developed economies are not immune to this worrying decline: the per capita renewable freshwater resources in United States, for instance, dropped from 15.106 m^3 in 1962 to 8.667 m^3 in 2017.

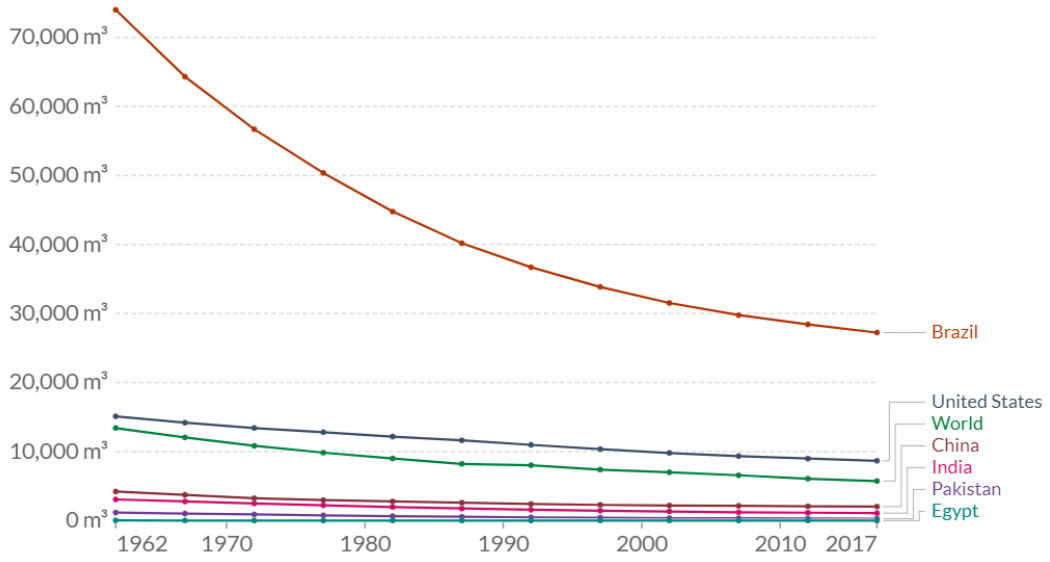


Figure 1.2: Renewable freshwater resources per capita. Source: Our World in Data (2021)

Globally, the amount of per capita freshwater available in a year has decreased by 20% in the past 20 years; regionally a more framed pictures emerges, with developing countries such as Northern Africa and Western Asia experiencing a decline rate of 30% (FAO, 2020).

[1] Internal renewable flows are internal renewable water resources, such as river beds, aquifers, and groundwater from rainfalls (Our World in Data, 2021).

This excess of demand over the available supply of the resource leads towards a condition which is labelled of 'water scarcity', where scarcity is expressed by unsatisfied demand, but also growing tensions between users, over-extraction of groundwater, and damages to the environment (FAO, 2012). Water scarcity refers not only to low or critical levels of water availability, but it also concerns limited access to a reliable supply of water and scarcity derived from the lack of adequate infrastructures (FAO, 2021). Indeed, beyond low physical availability, the causes of water scarcity may also be attributed to low income and institutional inability to manage the resource allocation. About 1.6 billion people suffer from what has been labelled as 'economic' water scarcity, a form of scarcity taking place when, despite physical water availability, local institutions and infrastructures are not able to guarantee safe and equitable access to water (UN, 2021a). These are problems which hit hardest and the poorest fractions of population, which struggle to reach a secure source of water. Big cities, especially in developing countries where the development of urban centres is fast and hard to keep under control, are an example of how people at the margins, living in the periphery and slums, are not able to access services of clen water and sanitation. The same is true for poor and isolated rural households, where water is not readily accessible and inappropriately controlled by more powerful subjects.

Future projections in a business-as-usual scenario are not bright. Data show there might be, in 2025, 1.800 million people living whit less than 500 m^3 per year per capita, condition which is defined as of absolute water scarcity, and a wide share of world population (about two-thirds) could experience conditions of water stress, with 500 to 1.000 m^3 per year per capita (FAO, 2021). This amount is not deemed sufficient to ensure all water uses: agricultural, industrial, and domestic (UNEP, 2012). Furthermore, data show that nearly half of the world population already experiences, at least one month per year, water scarce conditions, and this number could grow up to 5.7 billion by 2050 (Burek *et al*., 2016). Consequently, highly stressed areas, where water resources (especially the non-renewable ones, such as fossil groundwater) are always less available, are becoming more and more dependent on water-endowed countries (UN, 2017). Dependency does not relate to real water imports, which would be too expensive, but rather to what has been called *virtual water* (Hoekstra and Hung, 2002). This concept refers to the amount of water needed to produce a specific food or industrial good, which is to say the amount of water contained in that product. Countries hit by water scarcity may find it more profitable to import water-demanding goods, while increasing exports of those goods made from other highly available resources. This virtual water trade allows reducing the stress on national water reserves (*ibid*).

1.3. Water quality

Another important issue to deal with when analysing the state of water resources is water quality. Much attention has been put on the problem of reduced water availability, but the quality of the resource is as important. Not only is freshwater growingly scarce, but its use is increasingly constrained by water pollution. Most human activities produce wastewater, which in the 80% of cases is released in the environment without treatments (UN, 2017). Intensive agriculture, industrial production, mining, and urban wastewaters are the primary sources of water pollution (UN, 2015). Unprocessed wastewater infiltrates in the aquifers, or pollutes basins and lakes, affecting the quality of water and furtherly stressing the resource availability. What is more, lakes and rivers where pollutants are discharged are often those places where the poorest, with an already limited access to clean water, get their water from, thus increasing the risks of contracting diseases among this share of population (UNDP, 2006). Inequality in access to clean water emerges here as a central issue, not only in between regions, but also (and most importantly) within the same country and city. In high-income cities of Asia, Latina America, and Sub-Saharan Africa, for instance, there live people with access to hundreds of litres of clean water per day, at low prices; but in slums and rural areas of those same cities live people who can barely access 20 litres of water per day, the needed amount to satisfy basic human needs.

Access to quality water also relates to wealth and sanitation. According to UNICEF (2021), globally 2.2 billion people lack reliable access to safe drinking water, with the risk of contracting diseases such as cholera or dysentery. This is a problem especially for those which do not enjoy from safe sanitation, which today represents more than half of the global population (ibid). The most striking impact, however, is on children mortality: about 297.000 children under five still die from diarrhoea caused by poor sanitation and hygiene (UN-Water, 2021b). Access to quality water is an increasingly worrying issue also in big urban areas, where about 150 million people struggle to access safe and clean water for nourishment and sanitation, and this number could grow sevenfold, reaching more than one billion citizens, as population keeps on growing (Bompan and Iannelli, 2018).

1.4. Water and climate change

When talking about water, it is important to notice that growing population and growing consumption are not the only factors stressing the resource's availability. Climate change, a human-driven phenomena, is, year by year, furtherly increasing uncertainty of water provision and

precipitation patterns. Global warming is having consequences on the overall hydrological cycle, making it harder to maintain standard water levels in rivers, replenish aquifers, and avoid water pollution. This is a major problem for those people, notably the poorest, which rely for their subsistence on the monsoons, the rivers, the basins, or the drying land. A changing climate inevitably affects fishing stocks and harvests, consequently increasing food insecurity and food prices, and hindering poverty alleviation. Moreover, climate change is also the cause for a rising number of floods, draughts, extreme weather events, and rising temperatures. For these reasons, climate change can become a serious threat to development, especially in already water-stressed areas. Floods and drought, beyond ruining harvests and increasing food prices, might entail displacements and tensions, which can sometimes spur into conflicts; rising temperature will, on their side, furtherly increase water demand, especially from agriculture, which needs to deal with dryer and less productive lands, and from electricity, which will need bigger infrastructures and cooling systems (Bompan and Ianelli, 2018).

1.5. Water for development

The state of water resources as presented appears embedded in a worrying framework. Climate change, growing population, and changing consumption patterns are increasingly putting under stress water, an undervalued resource which is too frequently taken for granted. Many countries of the world are already experiencing water stress conditions (or they are about to). Data on water stress areas include most of developing economies, but developed ones are affected as well: even developed countries such as Spain, South Korea and Australia are ranked as water stressed (Chellaney, 2013). That of water stress is global threat leading many scholars to agree on the idea that we are experiencing a global water crisis, which is already affecting large portions of humanity. When per capita freshwater availability does not reach 1.000 m^3, water scarcity is believed to start obstructing economic development and public health, this way worsening existing plagues such as poverty, vulnerability, insecurity, and inequality (UNEP, 2012; UNDP, 2006).

The water-development nexus already emerged as a strongly relevant issue during the First Industrial Revolution. At the beginning of the 19th century waterborne diseases such as diarrhoea, dysentery, and typhoid fever were among the major causes of death, especially among children. In this industrializing world, people were getting wealthier, but indicators as life expectancy, infant mortality, and public health remained unvaried. Cities were offering job opportunities and increased incomes, but, simultaneously, they were exposing to dangerous illnesses. Water management and disposal were not a prerogative for the governments of the time, so that the rate of people dying by

waterborne diseases increased significantly, especially in peripheries and slums (a situation that is not that far from today major cities, especially in developing countries). Local and national governments made huge investments in policies of water management and in sewerage systems, this way improving living conditions, increasing life expectancy and reducing child mortality (HDR, 2006).

As a matter of fact, water is a vital resource for development, as it sustains key socio-economic sectors: it allows for irrigation in agriculture; it is indispensable for cooling energy-providing plants and to produce biofuels; it increases public health and human life; and it provides ecosystem services. However, water supply is increasingly difficult to manage, and demand keeps on growing at a worryingly rapid pace. This explains why water crisis is included among the major global threats to public health, food security, energy security, peace, and economic development (World Bank, 2016).

1.5.1. *Public health*

The water crisis widens already existing gaps in access to clean water and sanitation. The water, sanitation and hygiene sector (WASH), by providing water, can benefit people in several ways, such as improving living conditions, increasing productivity, reducing costs from health care, and increasing job opportunities (UN, 2021a). What is more, it can reduce poverty and mortality rates, significantly improving nutrition and decreasing the risk of contracting diseases such as diarrhoea and malaria, which are today among the main causes of death, especially in least developed countries (UN, 2015).

Gains from investing in water and sanitation can be seen also in the long run, with benefits that will encourage economic growth (UNDP, 2006). What is more, managing waste and improving water quality would create benefits to population. Improving water accessibility, sanitation and hygiene could have relevant consequences for children and women, the ones suffering more from lack of improved WASH services. Indeed, children mortality rate is very high because of unsafe drinking water and women lack clean services for their menstrual cycle and for their safety during pregnancy and childbirth. Furthermore, in regions where access to water is low, the nearest source could be hours far from home, and it usually is children and women which need to spend their time walking to collect water, time which is not spent in education or in earning income. Therefore, improving water facilities would also mean to positively affect school accessibility and to avoid disease contraction, this way reducing costs from medical expenses (UN, 2015).

Limited access to WASH services is a worrying threat especially in cities and informal settlements. Population growth and the increasing tendency to leave rural areas is making the lack of this fundamental access a great problem in rapid-growing urban areas. More than 50% of people in the planet live in cities, of which 30% live in slums, and this percentage is expected to keep on increasing (ibid). Providing adequate services, water supply, and sanitation is increasingly difficult, and the number of unserved people is already rising (WWAP, 2012). To improve water accessibility while continuing this expansion is a hard challenge that many governments are unable, or unwilling, to undertake.

This is a problem which emerges predominantly with the current covid-19 pandemics, that brought into light huge gaps in water accessibility and basic sanitation services. In many parts of the world, it is education on elementary and basic hygiene which is very low or inexistent: even a basic action such as washing hands with soap might be ignored. However, also where minimum knowledge exists, it is often the case that people lack access to clean water and soap to wash their hands. At the beginning of the pandemics, 2.3 billion people had no access to safe handwashing with soap and 670 million people lacked handwashing facilities (UN, 2021). Closing this gap in WASH would improve child nourishment, reduce physical and mental underdevelopment, and allow to save the lives of those 829.000 people which at present die every day because of unsafe water and poor sanitation and hygiene (UN-Water, 2021b).

1.5.2. Food and energy security

Water, food, and energy are central themes of the sustainable development agenda. The ongoing global changes (such as population growth, urbanization, and changing diets) are increasing demand in all of these three fields. That of water scarcity is a real problem for both food and energy security.

Agriculture is the main source of water withdrawals, and it will probably remain such in the future, given the growing need to produce food for the increasing world population. It uses water for irrigation, and it needs quality water for production and food, which demand is expected to increase up to 70% by 2025 (WWAP, 2012). Despite the amount of water available today could be enough to produce food for everyone, 800 million people are still hungry, and it is estimated that food production will have to increase by 50% to comply with the demand of a rising population (UN, 2015).

Energy and water are as well tightly linked. The water-energy relation is reciprocal: human beings need energy to use water, to extract, move and treat it; at the same time, water is fundamental in

generating energy. Globally, the 90% of power generation is water intensive (UN-Water, 2021c). Dominant energy production activities require a high amount of water: fossil fuels extraction, fracking operations, hydroelectricity, and cooling systems in thermal and nuclear energy production are examples of water demanding energy-producing processes.

It is becoming increasingly challenging for governments to comply with food and energy demand, while ensuring access to water for both industrial and domestic uses. For instance, demand is growing in the biofuels sector, rising competition with food production over land and water resources. Even sustainable and 'green' solutions, such as hydropower, present many weak points, especially when dealing with mega-dams limiting access to water to downstream populations or producing energy to export, rather than to comply with national requirements (Vallerani, 2014). Water scarcity in this sense would furtherly push agricultural and energy production, often at the expenses of the most vulnerable groups and of the environment.

1.5.3. Public security

With demand for water steadily increasing, many countries are reaching the limits of their own resources. A direct consequence is enhanced tension for the appropriation and use of the remaining sources of water. It is sufficient to acknowledge that less than 10 countries (Canada, Brazil, China, India, Russia, Indonesia, the United States, and the Democratic Republic of Congo) own the 60% of world freshwater resources (UNEP, 2102). The water crisis is rising tensions for water control between several stakeholders, including different economic sectors, especially agriculture, industry and domestic; different livelihood, such as farming and fishing; different countries; and between rural and urban areas within the same country, when different stakeholders share cross-border water resources or upstream management affects downstream populations. These conflictual relationships among water *uses* and water *users* are furthering already existing inequalities in access to water, with the major effects hitting the poorest and the most vulnerable groups, such as children, women, and indigenous populations (UN, 2015).

What is more, water scarcity is included among the causes of massive displacements, especially from rural to urban areas. The rural population finds it always more difficult to grow crops in arid and semi-arid lands and abandons farms to look for fortune in urban areas. When large scale displacements take place, it is often the case that tensions and conflicts arise in the new settlement, furthered by bad living conditions and increasing food prices (Femia and Werrell, 2013).

1.5.4. Economic growth

Access to water is of basic importance for its productive uses. For firms, plants, and family-run business, water represents a mean to support life, an income-generator and a push to economic productivity in different sectors (UN, 2015). An improved water quality and availability may boost investments in education and health, supporting a more self-sustained economic development. Investing in water can be attractive and improve returns, as a better water management can generate returns from the production system of firms and plants. However, economic growth is just one of the ways thorough which development can be achieved, as it is not enough on its own; there still exist wide gaps between the richest and the poorest, which need to be closed. Improved water management should be directed to improving economic growth, but also towards other goals, such as equality and ecosystem maintenance. Only in this way a sustainable development can be reached.

Thus, investments in this sector must be wise, in order to guarantee more quantity and quality of the resource, without damaging the ecosystem providing it. Investments in the WASH sector generate positive returns in serval fields. Each dollar invested in urban basic sanitation can generate a 2.5$ return and a 5$ return if spent in rural basic sanitation; similarly, 1$ spent in the improvement of urban basic drinking water could generate 3$ return, which would grow up to 7$ for investments in rural basic drinking water (UN-Water, 2021b). Moreover, investments in the water sector could trigger social benefits and support equity. It is estimated that the time lost in getting clean water (usually by children and women), which is considered as time not used to earn an income, and the lack of access to sanitation generate yearly a loss of about 260 billion US$. Additionally, access to safe water and a toilet domestically could reduce the household expenses on health care and could avoid numerous deaths, ultimately providing 18.5 billion $ in economic benefits (*ibid*). However, these investments must be coupled with care for the environment. The preservation of ecosystems appears fundamental also from the economic point of view, as investments in this direction generate benefits that widely overcome the costs of ecosystem maintenance. Tropical forests can be a case in point. This ecosystem provides water-related benefits, among which regulation of water flows, water treatment and purification, and reduction of risks of soil erosion, which can be valued at 7.236$, thus outdoing the value generated by carbon storage, food, timber, recreation, and tourism, all together (WWAP, 2012).

Thus, increasing water stress and reduced water availability could slow economic growth and hinder sustainable development; threat public health and food and energy security; induce displacements; and trigger conflicts. What appears important to underline is that water resources are

enough to satisfy the growing demand, and water stress could be rather caused by bad management and poor water allocation policies. This situation is negatively affecting the poorest and most vulnerable, the environment, and overall development, hindering progresses towards the sustainable development goals, poverty alleviation, and conflict mitigation (UN, 2015).

1.6. The global water crisis: international responses and national responsibilities

The data presented in the previous section display a worryingly unsustainable path, leading towards what scholars defined a global water crisis (UNDP, 2006). This global crisis finds its roots not only in the problem of physical water scarcity, a result of the ongoing climate change, but also in restricted access and decreased sanitation due to poor institutions and inadequate resource management. Indeed, water resources could be enough to satisfy the growing demand and it is rather the way they are managed and allocated which generates water insecurity (UN, 2015). Water security is rooted in power, politics and inequality, so that beyond complexities in the management of a scarce resource, hydro-political and transboundary issues should be considered (UNESCO, 2019). The main drivers of the global water crisis, in this sense, could be deemed political and governmental, rather than the decreasing physical availability of the resource. That of good water management should be a prerogative for policy makers, not just at the local level, but also at the national, regional, and international ones. A new approach is needed, which aims at integrating different scales and sectors when making decisions over a resource which plays a central role in almost every human activity. This is not just to avoid water depletion; good water management can also be fundamental in promoting a sustainable development path.

The international community seems particularly aware and committed to water-related issues. Since the 1948 Universal Declaration of Human Rights, several steps have been made towards the recognition of water as a human right. The process of recognition, however, was very slow. Few water-relevant conferences were held in the first decades since the Declaration. The 1977 Mar del Plata Conference held in Argentina was the first global meeting organized by the United Nation directly addressing the right of people to access water in quantity and quality which comply with their basic needs. The next water-relevant conference was held in New Delhi, India, and focused on principles of equity and universality. Another important moment in water management history was the 1992 International Conference on Water and the Environment, held in Dublin, which gave relevant inputs to the debate over freshwater problems (ICWE, 1992). The conference was organized by water experts and promoted by the World Meteorological Organization. The output of the conference was the Dublin Statement on Water and Sustainable Development. The document

represents a milestone in the water management realm. It recognizes water as a finite resource, rising the problem of water scarcity; it introduced water depletion issues, in particular as regards sustainable development and environmental protection, including in the list of threatened sectors human health, food security, industrial development, and ecosystems; it shed light on the urgency of more participatory decision making in the water sector; it acknowledged the role of women as core actors in fetching and safeguarding water; and it recognised the value of water as an economic good (which is still today a controversial point) (Franco *et al.*, 2013). However, it is only in the 2000s that we witness a faster advance: the 5th World Water Forum in 2009 defined, for the first time, water as a human need (Water Grabbing Observatory, 2021). This was just a foretaste of the decision undertaken the following years by the United Nations. In 2010 the international organization finally recognized the human right to water and in 2015 it recognized water and sanitation as two different but connected rights. Another important step was taken in 2015: the UN General Assembly adopted the Resolution 'Transforming our world: the 2030 Agenda for Sustainable Development'. As stated in the Resolution's preamble, the Agenda is a 'plan for people, planet and prosperity', which aims at promoting peace, larger freedom, and poverty eradication (UN, 2015a, p.1). It tries to do this by strengthening cooperation among stakeholders towards a shared and common path of sustainable development, displayed through 17 Sustainable Development Goals and 169 targets, which are 'integrated and indivisible' and aim at improving all the three dimensions of sustainability: economic, social, and environmental (*ibid*).

Recognizing the strong relation between water and development and the importance of a better water management to promote a sustainable growth, the 2030 Agenda presents a specific goal to address water issues. Goal number six, and its 8 targets, aim to 'ensure availability and sustainable management of water and sanitation for all' (*ibid*, p.14). What is more, looking at the Agenda it appears clear the importance of water for the achievement of the remaining 16 goals by 2030. Ensuring access to reliable and clean water resources and good water management positively impacts current global issues, such as poverty (SDG1), food security (SDG2), health (SDG3), gender equality (SDG5), energy security (SDG7), resilience and climate action (SDG13), environmental protection (SDG15), and peace (SDG16) (UNESCO, 2019).

The international community appears thus engaged and committed with water-related issues, even though something more could be done. Even in the recent G20 and COP26 meetings that of water scarcity and water resources depletion was not a major-interest theme and it barely accessed the table of discussion. Besides, UN resolutions are not compelling and there is no sanction for those countries which do not comply with the Agenda. The only adopted mechanism of control is the monitoring

system, allowing to understand the progress on the SDG. As regard SDG 6, today's rate of progress for clean water and sanitation for all is worryingly low (figure 1.3).

SDG 6 target area	Progress
6.1 Drinking water	Off track – progress rate needs to increase fourfold
6.2 Sanitation	
6.3 Ambient water quality and wastewater treatment	Insufficient data/likely off track
6.4 Water-use efficiency and water stress	Insufficient data/likely off track
6.5 IWRM implementation and transboundary cooperation	Off track – progress rate needs to double
6.6 Freshwater ecosystems	Off track

Figure 1.3: Progress on Integrated Water Resources Management - Global Indicator 6.5.1 Updates and Acceleration Needs 2021. Source: UN (2021b).

An important role in the development of SDG 6 is played by Aid Flows. The aid towards developing economies mainly comes from foreign donors, as the DAC, the OECD Development Assistance Committee, through Official Development Assistance (ODA). The aid is provided in the form of financial flows and technical co-operation, while credits and loans with commercial purposes are not included.

According to the OECD Development Assistance Committee (DAC), ODA (Official Development Assistance) can be defined as "government aid that promotes and specifically targets the economic development and welfare of developing countries" (OECD, 2021). The committee is in charge of monitoring ODA and every three years it draws up a list of countries and territories that benefit from these aids (consisting of the LDCs and other countries with low, lower middle or upper middle income based on per capita GNI) (DAC, 2021). The DAC also esteems that ODA are the main source of financing for development aid. In 2020 the overall value of these aids amounted to USD 161.2 billion, reaching an outstanding level due to additional spending deployed to help developing countries affected by the COVID-19 crisis. According to the Monterrey Consensus (UN, 2002), these aids are very important for those countries with limited capacity to attract private direct investments. In fact, they represent a critical instrument that can help those states achieving different purposes, including:

- Reaching adequate levels of domestic resource mobilization in a proper amount of time while enhancing human capital, productive and export capacities.
- Leading to growth through the improvement of the environment for private sector activity.

- Promoting education, health, public infrastructure development, agriculture, rural development and food security
- Reaching international goals

ODA can thus be addressed to different sectors, according to donors' aid programmes and objectives. Therefore, every specific issue can be dealt with specific policies. As regard the Water Supply and Sanitation sector (SDG 6), the global amount of ODA in 2019 is USD 5206.58 million, growing by USD 304.4 million since 2018. However, the water sector performed poorly with respect to the overall growth in ODA. Indeed, combining all the sectors, ODA raised from USD 123484.96 million in 2018 to USD 127416.44 million in 2019 (OECD.Stat, 2021).

It is estimated that the rate of progress should at least double in order to achieve the minimum thresholds established by the 2030 Agenda, as 129 still lag in reaching goal number 6 (UN, 2021c). This responsibility falls mainly on national governments, which should do their best to implement better policies to comply with the international Agenda. The role of local and national institutions is particularly crucial in the management of natural resources, especially when the economies are characterized by an abundance or a scarcity of a resource. In these cases, institutions can determine whether the resource abundance/scarcity will be a curse or a blessing for the economy (Badìa-Mirò *et al.*, 2015). Given the increase in water stress as a consequence of previously cited water issues, the need for good, transparent, just, and engaged institutions appears increasingly compelling.

There are many cases around the globe which present always higher levels of stress. Sub-Saharan Africa and South Asia account for the most worrying rates for water depletion, poor sanitation and inadequate water management policies (World Bank, 2020).

The regional level is another important stage where relevant measures can be undertaken. Regional cooperation appears fundamental when dealing with water resources management, as usually water bodies (lakes, rivers, aquifers) are shared among different shareholders. An integrated management approach appears fundamental to avoid increasing tensions and safeguard the resource. Data on international cooperation in the water sector obtained through the SDG 6 monitoring present a negative picture. Barely 58% of transboundary basin areas agreed on a water cooperation project and only 24 out of 153 countries sharing lakes, rivers and aquifers made agreements on all their shared water resources (UN, 2021c).

CHAPTER 2
WATER RELATED IMPACTS OF FDI IN DEVELOPING COUNTRIES: BETWEEN GROWTH AND SUSTAINABLE DEVELOPMENT

Chapter One presented the state of water resources, emphasising the increasing stress human activities (and human driven phenomena such as climate change) are exerting over a resource which is at the heart of a sustainable development process. The water related issues discussed in the previous section, hit the poorest harder. Countries which show low rates of HDI are also countries which present poor levels of access to clean water and sanitation. These regions still present high levels of food insecurity, malnutrition, water-related diseases, infant mortality, and school drop rate (Kumar *et al.*, 2008). Weak institutions are proven to be a strong deterrent for overcoming these obstacles which, in many cases, are trapping the economy in a spiral of underdevelopment and high inequality. That of balancing economic growth and sustainable development seems a particularly difficult task for developing countries' governments, which are more easily subject to regulatory capture behaviours, aimed at favouring domestic and foreign investors, rather than the whole population. Given the importance of foreign direct investments (FDI) for developing countries' economies, the focus of this second chapter will be on the effects that foreign capital may have on the host economy, focussing on the limits these may pose to access and use of water resources. Inevitably, the analysis will refer especially to the marginalized and poor fractions population: the effects of an increasingly limited access to water will probably hit the poorest, while the wealthier are supposed not to experience water access constraints (Rudra *et al.*, 2018).

After generally introducing the debate over FDI and the role they play in developing countries' development path, the first part of this chapter will present the current trend of global FDI and the main issues related to the effects of FDI on water quality and quantity in developing countries, especially the way in which they can affect access to clean water and sanitation of the poor and marginalized fractions of population. In the second part of the chapter, the concept of *water grabbing* will be introduced. Following the trends reported in the first part, this second section will focus on an against-the-trend FDI flow in renewable energies and will deal especially with the most water demanding technologies: biofuels and hydropower. Examples from the world will be presented along the chapter, highlighting the global character of the issue.

PART ONE: FDI, Water and Sustainable Development in Developing Countries

2.1. FDI flows to developing countries

According to the OECD, "Foreign direct investment reflects the objective of establishing a lasting interest by a resident enterprise in one economy (direct investor) in an enterprise (direct investment enterprise) that is resident in an economy other than that of the direct investor." (OECD, 2008, p.22). This implies a long-term relationship between the two actors and a certain degree of management and control by the direct investor of the enterprise abroad (*ibid*). There exist different types of FDI, including greenfield investments, cross-border M&A, and international projects finance deals; however, for the scope of this research, attention will be addressed mainly towards greenfield investments. Indeed, these kinds of investments account for the highest share of global FDI flows and, what is more important for the current thesis, they are the most important FDI inflows for least developed and developing countries and the ones in which we can expect a direct link with water (Rudra *et al.*, 2018; UNCTAD, 2021)

There seems to be a relevant gap in FDI flows between developed and developing countries. Specifically, FDI outflows appear higher in developed countries, while FDI inflows seem channelled into developing economies. However, the 2021 World Investment Report (UNCTAD, 2021) shows how the Covid-19 pandemic deeply influenced this trend, and developing countries, which accounted for less than half of global FDI, increased their total share up to two thirds of FDI flows (figure 2.1). What is more, due to the pandemics, global FDI flows dropped by 35% from 2019 to 2020, 20% lower than the one reached during the 2009 financial crisis (*ibid*).

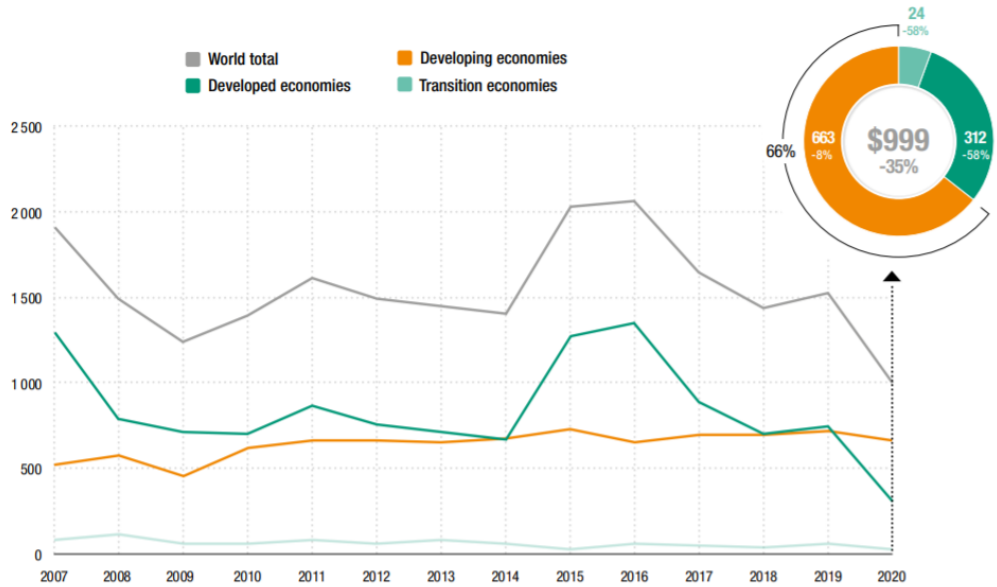


Figure 2.1.: FDI inflows, global and by group of economies, 2007-2020 (billions of dollars and per cent). Source: UNCTAD, World Investment Report 2021

The strongest impact for FDI was experienced by developed countries, where the registered decline rate was of 58%; contrarily, developing economies experienced a much slower decline (8%) (*ibid*). Despite the less steep decline, the effects of this downturn hit poorer nations harder. Indeed, developing countries have been severely affected by the sinking of greenfield investments, on which they strongly rely to sustain economic growth. Relevant differences emerge regionally, which make clear how developing countries are those suffering the most from the pandemic recession, mainly because their ability to respond to the crisis are limited. In Africa, for instance, FDI flows dropped just by 16% (compared to 80% in Europe); yet, greenfield projects, at the heart of industrialization prospects, downturned by 62% and for now they seem not to recover their initial trend. The situation is worrying also for Latin America and the Caribbean region, where FDI fell by 45%, hitting hardest on natural resources and tourism, both core sector for the region's economies. Likewise, least developed countries show stable FDI inflows levels, but deals on international projects finance and greenfield investments dramatically fell. The only exception to this trend is represented by Asia, where FDI inflows were more resilient. For countries such as China and India, FDI inflows proved not only to be resilient, but also to increase (*ibid*).

Another great problem emerging for FDI as a consequence of the health crisis is the fall in investments in SDGs-related sectors. Core sectors such as power, food and agriculture, and health, which were already problematic, were furtherly weakened by Covid-19 pandemics (*ibid*).

2.1.1. FDI flows to developing countries: A curse or a blessing for the host economy? The scholarly debate

The role of foreign direct investments in promoting growth of developing countries has been extensively debated. Scholars are polarized between different positions. Some believe FDI should be considered as a blessing for the host economy, while others support the idea that foreign capital flows from wealthier economies hinder development of poorer nations. Additionally, according to some school of thought, FDI have no relevant impact on the host economy development. A fourth position holds that FDI can have mixed effects on the host economy and consider national and local specificities as key determinants of the blessed or cursed character of FDI inflows.

Scholars supporting the idea that FDI can be a blessing for the host country use as a main argument the improvement effects on productivity and economic growth. They agree that foreign direct investments can promote domestic investments and that foreign firms can contribute to improvements in technological knowledge of the host country's economy, creating spill over effects that could

ultimately lead to higher productivity and competitiveness (Siddiqui, 2015). Indeed, major benefits from FDI inflows are reported on knowledge and skill acquisition, competitiveness of domestic firms, backward and forward linkages across sectors, productivity, employment and trade, technological development, domestic investment, and stock values (Johnson, 2006; Iamsiraroj and Ulubasoglu, 2015).

Additionally, FDI may lead to an increased inflow of physical capital and labour (*ibid*). A growing physical capital could improve the productive capacity of the host economy and demand for labour could increase because of more substantial FDI inflows, this way increasing real wages. Knowledge capital transfer is another way through which FDI can promote economic growth in the host country. The spill over effects which can result from technology transfer can take place through imitation, reverse-engineering, and supplier linkages, and could be considered as the major benefits that FDI can bring to the host economy, as these positive effects are proven to be persistent (*ibid*). Taking a different perspective, there are also scholars supporting the idea that foreign investors are instead attracted by already growing, politically stable economies, and would retreat from a market as soon as risks increase (Vaknin, 2007). According to this point of view, FDI are not the source of economic growth, but a direct consequence of an already started process of economic improvement.

Supporters of the "cursed" character of FDI believe these foreign capital inflows hinder economic growth. For instance, FDI can negatively impact growth in the host economy through distortions, especially when these are coupled with overly beneficial advantages from local governments to foreign firms. When acting in distorted economies, FDI may not impact economic growth and rather trigger a process of income redistribution among new actors in the domestic market, worsening inequality issues (Iamsiraroj and Ulubasoglu, 2015). Furthermore, FDI might have a crowding out effect on domestic investments, this way redirecting resources (which in some developing countries may be already scarce) towards different productive sectors (*ibid*). Other negative impacts recognized are: the negative effect on competition, especially in developing countries, where small domestic firms lose market shares to big multinational firms and risks for monopolisation of national markets are higher; the possible negative impacts on the Balance of Payment (BoP); and the loss of control over domestic commercial activities (Alhijazi, 1999).

Additionally, for foreign direct investment to positively impact host economies, the national capacity of absorption should be considered. Local features of the host economy, such as the GDP rates, the education rates, the levels of political instability, the stock of human capital, and the spread of informal economy, are all variables which can influence the effects of FDI on the host economy (Narula, 2004; Li and Liu, 2005; Iamisaroj and Ulubasoglu, 2015). Indeed, the absorptive capabilities

of the host economy are pivotal in determining the long-term impact of FDI, as poorer economies may struggle in reaching the threshold requirements allowing them to benefit from these capital inflows (Li and Liu, 2005). What is more, there could be economies which experience a mixed impact from FDI inflows, with some of the previously cited features improving, while others declining because of increased foreign capital inflows (Iamsiraroj and Ulubasoglu, 2015).

Another position taken to address the FDI-growth nexus debate is that supporting the idea of a mixed impact of FDI inflows. While supporting a major school of thought which recognises the positive effects that foreign direct investments may have on the host economy, these studies also highlight the contradictions of foreign capital inflows. Resource-transfer is among the major benefits identified. FDI by foreign firms usually involve capital, technology, and labour skills transfer to the host economy, particularly beneficial for developing countries, where these resources are scarce; however, these benefits may be highly limited, especially when FDI entail the settling of entirely foreign-owned branches (Alhijazi, 1999). Employment is another aspect which could positively affected by FDI inflows. Among the major arguments of positive narratives supporting FDI inflows there is the idea they can create job opportunities, both directly and indirectly (e.g. boosting demand in other sectors); yet, national firms may lose shares of market to the new foreign investors, and the new job opportunities created by the foreign firm may reveal themselves as mere substitution of national firms' job losses (*ibid*).

The impact of FDI on the host economy, thus, appears strongly related to variable features which characterise the single country. FDI might entail economic growth, but corruption, human capital, the host country's export promoting strategies, financial and institutional developments are all factors which should be considered when determining the effects of foreign direct investments in the host economy (Gökmenoğlua *et al.*, 2018). There is still not a straightforward solution to the debate over the blessed or cursed character of FDI; the impacts of foreign capital inflows can be positive, negative, neutral, or mixed based on the economic, institutional, regulatory, and technological features of the host economy (Johnson, 2006; Li and Liu, 2005; Alhijazi, 1999).

2.1.2. FDI flows into developing countries: regional perspectives

Narula (2004) identifies two different categories of foreign direct investments: asset-exploiting and asset-augmenting. The former includes FDI that aim at extracting natural resources, reaching new markets, or reorganizing existing foreign production; the latter includes those investments which look for new strategic assets. Developing countries are believed to attract investments belonging to the

first group (*ibid*). Current FDI trends, affected by the Covid-19 pandemic, are reported hit more severely asset-exploiting than asset-augmenting FDI flows (UNCTAD, 2021). Indeed, commodity-dependent countries (mainly developing and least developed economies) suffered more from the on-going health crisis than non-resource-based economies (UNCTAD, 2021).

What is more, globally, the most negative effects were reported on announced greenfield projects and international project finance announcements. This is especially concerning for developing countries: a negative trend in FDI shows resistance from foreign investors, which may deem it too risky to invest in developing countries during a health crisis. Foreign investments such as greenfield investments and international project finance represent key funds for large infrastructure projects and are believed to be relevant for emerging economies' development process (*ibid*).

Figure 2.2 presents the rates of announced greenfield projects for developing economies. It appears clear that the health crisis in these countries impacted the most on natural resources-related sectors, while low- and high-skill industries suffered less. The most severe decline was found in Africa, where greenfield announced projects decreased by 75%. The rate of decline was less abrupt in Latin America and the Caribbean, where it reached 46%, and in Asia, where it did not exceed 40%.

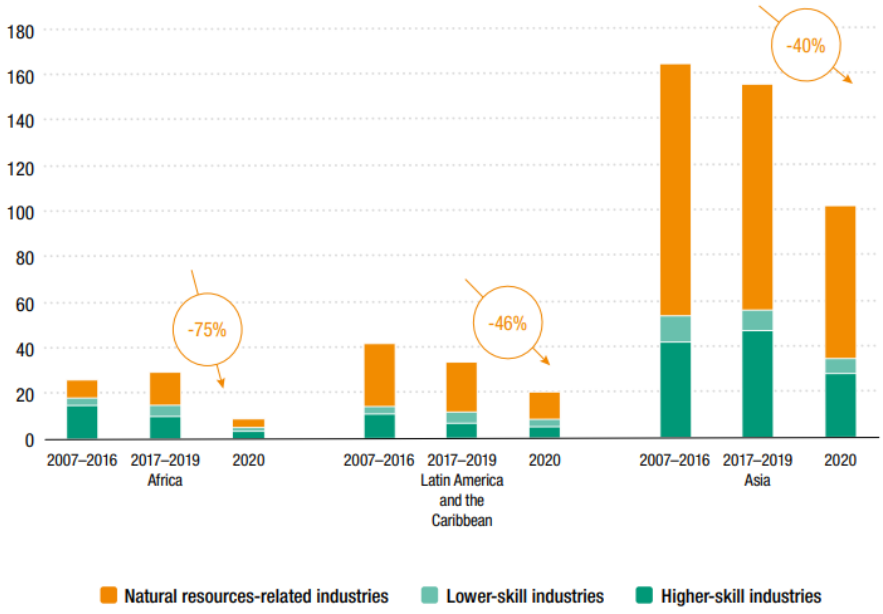


Figure 2.2: Developing Economies: announced FDI greenfield projects in manufacturing by value (billion of dollars and per cent). Source: UNCTAD, World Investment Report 2021

A quick overview on the effects the pandemics is having on FDI inflows in developing regions is necessary in order to understand the current and future trends. According to the 2021 World Investment Report, developing countries will drive global FDI growth rates in the near future,

especially East and South-East Asia (*ibid*). Developing economies FDI trends will then be further analysed below, relying on the data presented in the above-mentioned report.

❖ *Africa*

Greenfield projects and international projects finance are FDI flows which experienced the most severe drop. Announced greenfield projects, a primary booster for FDI inflows, declined by 62%, while international project finance, important for large infrastructures projects, decreased by 74%. This decline was perceived as particularly problematic by highly resource-dependent economies, following the downward slope of both prices and demand for energy commodities. The highest share of FDI inflows in Africa is directed to greenfield projects, which are mainly concentrated in the services and manufacturing sectors. Main industries attracting greenfield FDI in the region are information and communication, energy, coke and refined petroleum, food, beverages and tobacco, transportation and storage, and automotive. An especially worrying decline is that observed among investments in SDGs-related sectors (2.1.3.). As regards future projections, FDI in Africa are believed to increase by 5% but this will not be enough to reach pre-pandemics levels. The African Continental Free Trade Agreement (AfCFTA), which is lowering barriers to intraregional trade, might represent an important booster for FDI flows in the region; however, the recovery is believed to be slow, as the pandemic contributes to the heighten risk for foreign investments in Africa.

❖ *Developing Asia*

The case of Asia is of particular interest, as it seems to be the only region showing resilience in FDI inflows despite the Covid-19 pandemics. Main sectors attracting FDI in the region are technology, financial services, and consumer goods. Investments in the region grew by 4% in the last year. However, an analysis from within the region reveals important differences among sub-regional economies. Fast-growing and large economies such as India and China experienced an increase in FDI flows and are thus believed to be the engine and main drivers of FDI resilience in Asia; but poorer economies, especially those relying on tourism or manufacturing, were negatively impacted by the pandemic. South-East Asia, for instance, was a key recipient of FDI before the health crisis, but in 2021 FDI are reported to have decreased by 25%. What is more, despite the signs of resilience in some sectors, also Asia experienced a concerning decline in investments in SDGs related sectors (2.1.3.). Forecasts for FDI flows in Asia project a continuous growth. However, the high uncertainty

over the pandemic's evolution creates some doubts on South Asian abilities to respond to other waves and maintain the current positive trend in FDI flows.

❖ *Latin America and the Caribbean*

Following the Covid-19 pandemic, FDI in Latin America suffered the most severe economic decline among developing countries. Pre-pandemic data already displayed a declining flow in FDI flows, and the pandemic acted as a booster for this trend. Greenfield investments and international project finance dropped significantly, as funds swept away from relevant economic sectors such as automotive, hospitality and energy. The only resilient data come from announced project finance deals in renewable energy. However, Latin America makes no exception to the trend of decreased SDGs-related investments common to all developing countries. In Latin America, investments directed towards the Sustainable Development Goals experienced steep downturns, with special regard to spending in transports, energy, and telecommunication (2.1.3). Forecasts for Latin American FDI flows report that inflow rates will stabilize by 2021, but it will probably take longer for this region to recover, compared to other developing economies.

2.1.3. FDI and sustainable development goals (SDGs) in developing economies

Developing countries have been proven to be severely affected by the pandemic and the consequent decline in FDI inflows. A cause of great concern is the effect the health crisis has on SDGs-related sectors. When analysing regional impact of FDI, it stands out the shared difficulty among developing and least developed countries in complying with the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals.

As the goals were about to be set, in 2014, UNCTAD estimated the gap which separated current investments from the investments required for the achievement of the 17 SDGs by 2030. As regards developing countries, UNCTAD estimated that $2.5 trillion investments per year were needed in 10 SDGs-related sectors for the gap to be closed by 2030. Major areas of investments were basic infrastructures, food security, climate change mitigation and adaptation, and health and education (UNCTAD, 2020). When looking at the progresses performed in these 6 years, it appears clear we are still far away from closing the gap. Not only this; the Covid-19 pandemic represents a huge obstacle for the achievement of the goals, especially in developing countries. Not only is the pandemic slowing the pace of SDGs achievement, but also it is cancelling the progresses made until now (*ibid*).

SDGs-relevant foreign investment in developing economies declined by 33% since the pandemic started. Announced greenfield projects and project finance addressed to SDGs-related sectors experienced the steepest drop. This backward step regards all sustainable development goals, even though goal number 13 on renewable energy promotion seems not to be relevantly affected by the health crisis (figure 2.3). Indeed, investments in SDGs declined by a range included between 35% and 67%, but investments in renewable energy exceptionally decreased by only 8% (*ibid*).

Figure 2.3.: The pandemic impact on investment in SDGs: announced greenfield and project finance, change in value, 2019-2020 (per cent). Source: UNCTAD, World Investment Report 2020

Many governments answered to the crisis through national recovery plans, which generally aim at promoting resilience and sustainability. It is estimated that these recovery plans may ultimately exceed $10 trillion, which could account for one third of the estimated SDG investment gap (*ibid*). However, the core recovery projects have been planned by and for developed economies, with developing countries only holding 10% of these recovery spending plans.

Growth in investments which positively impact SDGs was reported to be too low in developing countries even before the pandemic spread. Important sectors such as education and water and sanitation have shown no signs of improvement, and rather showed declining levels of investments. What is more, even for sectors in which presented data appeared brighter, such as climate change mitigation and health, the efforts that have been made seem not enough to close the investment gap (*ibid*).

Regionally, FDI towards SDG-related sectors in Africa significantly declined in 2020. This was true for all sectors but renewable energy, for which international project finance increased by 28%. Contrarily, greenfield investments in food and agriculture declined by 78%, those in health by 58% and investments in education were reduced by 45%. This came with concerning consequences,

such as the enlargement of the already existing gap in human capital and higher value addition in natural resources.

In Asia, investment in SDGs-related sectors followed the lead of the other developing countries. Indeed, international project finance deals increased, driven mainly by Viet Nam, which accounts for 40% of these projects. FDI in this filed are expected to keep on increasing, as countries such as China, Republic of Korea, Saudi Arabia, and some South-East Asian countries encourage the adoption greener solutions (UN, 2021). Investments in infrastructure, on the other hand, dropped, as did investments in health, food and agriculture, health, education, and water and sanitation (*ibid*).

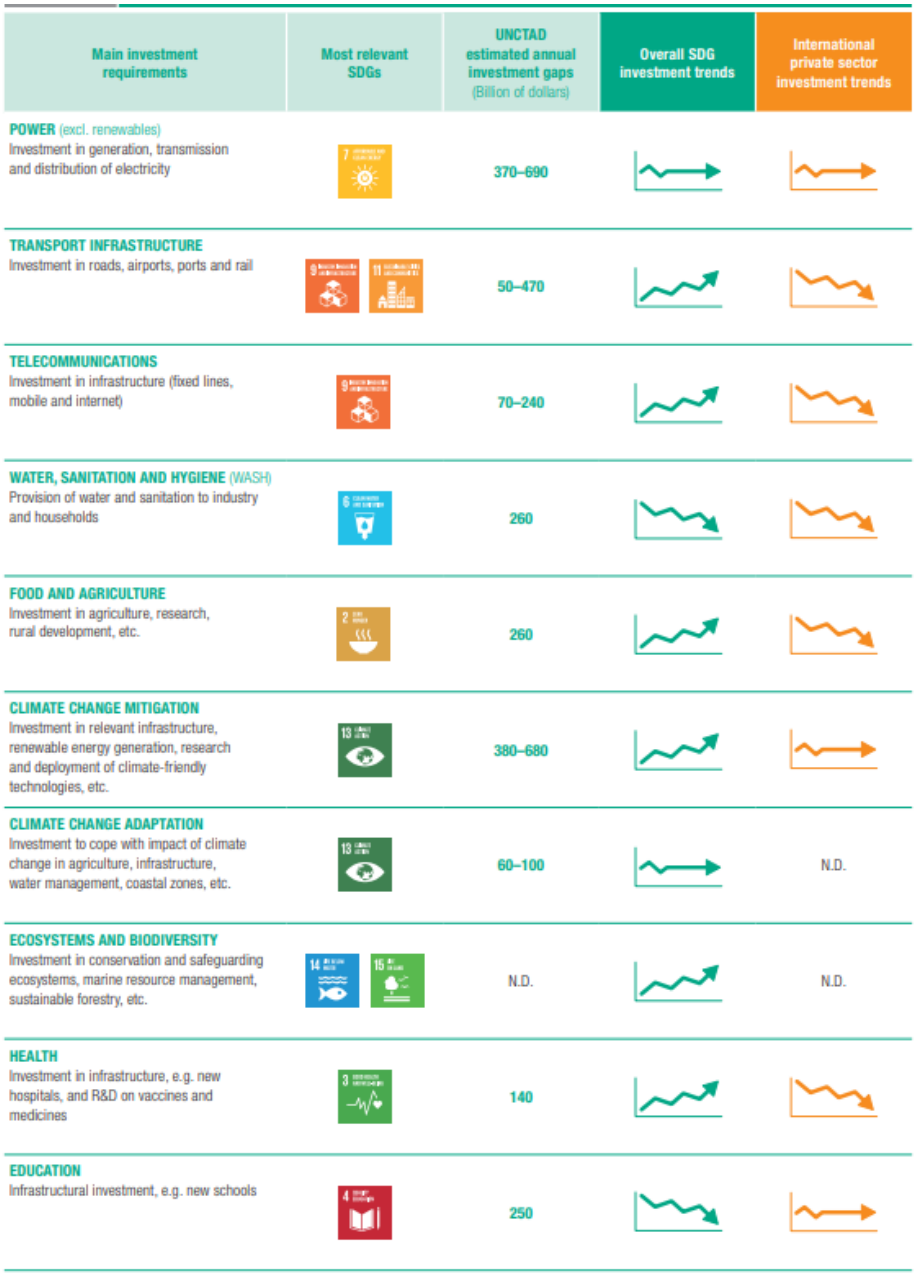
In Latin America and the Caribbean region, the trends already presented for the other developing countries are repeated. Data present a sharp decline in investments for all SDGs-related sectors, except renewable energy, which maintained pre-pandemics levels. The major decline was registered in education, were FDI lowered by 86%. The most concerning decline has been registered in the infrastructure sector, where investments including transport, telecommunication, and energy dropped by 75%. The health crisis only worsened an already concerning trend, as declining investments in this sector are believed to be a major obstacle to the growth of the region (UNCTAD, 2021). Other deeply affected sectors are food and agriculture and, despite the pressures for improvements from the pandemic, health.

In conclusion, data relating to current FDI trends report the failure in promoting and implementing sustainable development investments (*ibid*). Especially in developing countries, foreign direct investments are not sufficiently addressed towards the achievement of the 17 SDGs. The pandemics should not be considered the main cause for this incompliance; investment in SDGs-related sectors were already too low before the pandemics. However, it seems undeniable that the health crisis we are experiencing is furtherly stressing and reducing the investments flows to these sectors, and, in some cases, it is even undoing the few steps forward made until now.

2.2. FDI, Water, and Sustainable Development

As demonstrated above, the current Covid-19 crisis is negatively affecting investments in sustainable development in developing countries: it is estimated that the pandemics diverted $400 billion in least developed and developing countries, which could have been used for SDGs-related investments (WaterAid, 2020). Goal number 6 on water, sanitation, and hygiene makes no exception to this trend. Rather, as appears comparing the data presented in the 2020 World Investment Report elaborated by UNCTAD, this goal seems to be the most severely affected by the pandemic.

As showed in figure 2.4, investments in the WASH (water, sanitation, and health) sector are the only ones registering a relevant decline both in overall investments trends and in international private sector investment trend. This obviously represents an obstacle to the attempt of closing the annual investment gap in SDGs-related sectors, estimated at $2.5 trillion by the year of their application (UNCTAD, 2014).



Main investment requirements	Most relevant SDGs	UNCTAD estimated annual investment gaps (Billion of dollars)	Overall SDG investment trends	International private sector investment trends
POWER (excl. renewables) Investment in generation, transmission and distribution of electricity		370–690		
TRANSPORT INFRASTRUCTURE Investment in roads, airports, ports and rail		50–470		
TELECOMMUNICATIONS Investment in infrastructure (fixed lines, mobile and internet)		70–240		
WATER, SANITATION AND HYGIENE (WASH) Provision of water and sanitation to industry and households		260		
FOOD AND AGRICULTURE Investment in agriculture, research, rural development, etc.		260		
CLIMATE CHANGE MITIGATION Investment in relevant infrastructure, renewable energy generation, research and deployment of climate-friendly technologies, etc.		380–680		
CLIMATE CHANGE ADAPTATION Investment to cope with impact of climate change in agriculture, infrastructure, water management, coastal zones, etc.		60–100		N.D.
ECOSYSTEMS AND BIODIVERSITY Investment in conservation and safeguarding ecosystems, marine resource management, sustainable forestry, etc.		N.D.		N.D.
HEALTH Investment in infrastructure, e.g. new hospitals, and R&D on vaccines and medicines		140		
EDUCATION Infrastructural investment, e.g. new schools		250		

Figure 2.4: Summary of SDG investment gaps and directional trends. Source: UNCTAD, World Investment Report 2020

FDI flows towards SDG 6 are an especially concerning issue for developing countries. Here, even before the pandemic spread, investments in this sector were low, compared to other SDGs. In the period 2010-2014, FDI in SDG6 stood at only 0.3 billion dollars, the lowest level registered among

SDGs and things remained unchanged for the following years (UNCTAD, 2020). However, the deepest decline in investments in the WASH sector was registered as a consequence of the pandemic. By 2020, greenfield projects directed towards SDG 6 in developing countries dropped by 68% in value, the worst performance if compared to other SDGs; international projects finance dropped significantly, too, decreasing in value by 66%. Developing Asia, which is considered among the worst performer in closing SDGs financial gap, reports a steep decline form 1479 million dollars in 2019 to 259 million dollars in 2020 (*ibid*).

Beyond the quantity of investments directed to the WASH sector, there are also concerns over the quality of these capital flows. According to the FDI Qualities Indicators Report, industrial production is a major water pollutant and a promoter of unsustainable water use. Foreign manufacturers may play a key role in encouraging better and more sustainable practices and FDI could be used for investing in water management and infrastructure development (*ibid*). However, the current (and past) practice seems quite far from this: investments trends in SDG 6 are low and their impacts on water resources is controversial.

Generally, recent research on the FDI impacts on host economies has focused on the impact of FDI inflows on natural resources and their management (Long *et al.*, 2017). Some scholars interestingly couple the theory of foreign investment dependence to environmental impacts (Long *et al*, 2017; Jorgenson, 2014). According to the dependency theory, broadly accepted especially among Latin American economists, foreign firms maintain the headquarters in developed countries, but settle their branches in foreign, usually less developed, economies. As a consequence, they think FDI trap the local economy in a dependency relation with the foreign investors. This is also known as the *treadmill of production*, a theory according to which "developing nations are left to deal with the consequences of the production treadmill, while wealthy nations can continue to enjoy high levels of consumption" (Caycedo, 2018). Combining these theories with an assessment of the environmental soundness of FDI, these scholars conclude that such investments can contribute to social and environmental degradation in two different ways: ecological addition and ecological withdrawals.

The former includes the additional outputs of production processes which are added to the environment, such as pollution; the latter refers to the natural resources taken from the environment to allow production (Long *et al.*, 2017). Additionally, FDI could hinder economic growth, favouring natural resources overexploitation and causing an overreliance of the host economy on natural resources sector as a source of income (*ibid*). Thus, following this point of view, it seems that ultimately FDI can promote an unsustainable use of natural resources.

This general debate can be applied to the more specific debate over FDI impacts on water resources. Indeed, possible effects of FDI could be water pollution (ecological addition, e.g., taint industries) and overexploitation of groundwater resources (e.g., for agriculture irrigation systems in Large Scale Land Acquisitions), previously identified as core problems of the current global water crisis (CH1). Negative impacts on the quality and quantity of water resources inevitably affect local people too, especially the poorest and marginalized portions of population, which usually lack access to water services and rely on groundwater for their daily subsistence. Examples of bad practices by governments and private actors in the water sector are not an exception in the global realm. These practices are known under the label of *water grabbing* and will be the focus of the next section.

PART TWO: FDI Impacts on Water Resources in Developing Countries – The Water Grabbing Syndrome in the Renewable Energy Sector

2.3. Defining water grabbing

The relation between foreign direct investments and water use appears complex. FDI can have relevant positive effects on the host economy. This is true when investments are directly addressed to WASH services and SDG 6. As a matter of fact, these kinds of investments are reported to improve productivity, health and health costs, school attendance, gender equality, and living conditions (Karadima, 2021).

However, FDI can also negatively impact (both directly and indirectly) water resources and their management in the host country. Following the approach introduced in the above section, Rudra *et al.* (2018) supports the idea that FDI can hinder access to potable water through two channels: contamination (ecological addition) and depletion (ecological withdrawals). Multinational enterprises (MNEs) are major actors in perpetrating these forms of water degradation, as they usually consume lots of water and discharge large amounts of wastewater directly in rivers, this way negatively impacting water quality and quantity for local and downstream populations. In fact, major water-consuming and water-polluting sectors in developing countries are also sectors which are heavily supported by FDI (Neafie, 2018). As pictured in figure 2.5, constraints on access to potable water have been proven to be much stronger in developing and least developed countries, where the share of poor and marginalized population is high (Rudra *et al.*, 2018). Indeed, it is more frequent in these cases to observe weak institutions, which are more vulnerable to regulatory capture by MNEs; additionally, there usually is low political engagement, and mobilization among social groups is

feeble, because these international companies are praised for creating new jobs and rising national income. However, this is just one side of the story. Poor people at the margins of society are the most affected by these large-scale investments, especially when dealing with water impacts and water pollution: we can assume wealthy people already have a safe and reliable access to clean water, while the poorest still rely on groundwater and wells for their daily water provisions (*ibid*). On the contrary, where the share of poor and marginalized population is lower, regulatory capture behaviours are hindered, demands for water reforms are more frequent and access to clean water is guaranteed for most of the population (Rudra *et al.*, 2018; Neafie, 2018). When political contestation is weak or inexistent, regulations tend to be much more permissive with water grabbing practices (Franco *et al.*, 2013).

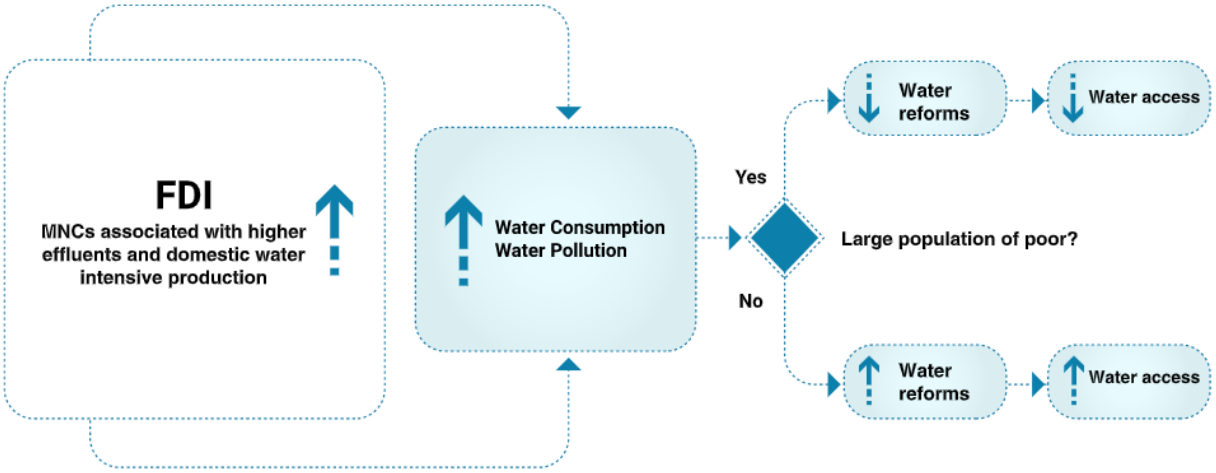


Figure 2.5: Impacts of foreign direct investment on potable water access. Source: Rudra *et al.* (2018)

MNEs are increasingly important actors in global dynamics. At the time of the Dublin International Conference on water and the environment, the main actors involved in water management were states and national institutions. However, now these new actors are emerging, and with them also new economic and political rules and relations. If initially attention was mainly on water delivery and the connected infrastructures, today we witness a shift towards the resource itself and, consequently, its privatisation (Metha *et al.*, 2012). Attraction of private investments by national governments is considered as one of the main drivers of the current global rush for water (*ibid*). There is evidence of rivers being privatised to generate energy, of water reallocation to powerful corporations, and law and policies adapted to allow for this (*ibid*).

When powerful economic actors manage to take control, or to successfully reallocate to their own needs, water resources at the expense of local communities which directly used those resources or depended on the aquatic ecosystem they maintained, we can talk about *water grabbing* (*ibid*; Bompan

and Iannelli, 2018). Water grabbing in developing countries entails several issues, such as unequal power relations, a blurred line between legality and illegality, human rights violations, corruption, and tensions among different stakeholders. These practices can have both social and environmental consequences. Social impacts can be furthered marginalization, forced migration, water scarcity, low water availability, and constraints in water access for local and downstream communities; environmental impacts mainly regard water contamination and biodiversity loss (Dell'Angelo *et al.*, 2018). This inevitably leads towards growing concerns for the spur of water-related conflicts, with some spreading narratives of 'water wars' and conflicts for the 'blue gold'. Ismail Seragelding, former functionary of the World Bank, famously predicted in 1995 that wars in the 21st century will be fought over water, rather than oil.

Scholarly debate generally tends to associate water grabbing with the more broadly studied phenomenon of *land grabbing*[2] and believe the two concepts are intrinsically connected. This is in part true, but water grabbing can take different forms, other than agriculture-driven resource grabbing, such as the mining and hydropower development. What is more, it can be physically, but also legally grabbed: it is common, when dealing with water grabs, to witness the seize of water rights of the people which previously accessed those same water resources (Metha *et al.*, 2012). The type of water grabbed is also a determinant for different water grabbing practices. Scholars distinguish among 'blue' and 'green' water grabs. The water taken from aquifers, lakes, or flowing in rivers, is labelled 'blue water', while the term 'green water' refers to rainfall water and the water which re-enters the water cycle naturally, through evaporation (AtctionAid, 2015).

To sum up, water grabbing can take several different forms, thus making it hard for scholars to formulate a broadly shared definition of the concept. What is shared by all perspectives, however, is that these practices of water resources appropriation entail injustice and power imbalances, with major disrupting effects on the marginalized and most vulnerable fractions of population, especially the rural poor, which, due to water grabbing, suffer from increased environmental degradation and socio-economic marginalization.

[2] We still lack a globally shared definition. However we can rely on the definitional framework proposed by Eco Ruralis, which defines land grabbing as "*the control (whether through ownership, lease, concession, contracts, quotas, or general power) of larger than locally-typical amounts of land by any person or entity (public or private, foreign or domestic) via any means ('legal' or 'illegal') for purposes of speculation, extraction, resource control or commodification at the expense of peasant farmers, agroecology, land stewardship, food sovereignty and human rights.*" (Eco Ruralis, 2016, p.1)

The actors involved in water grabbing practices are several and vary according to the type and scale of the grab. On one side there are those people suffering the grab, which are the original users, often poor and vulnerable people which endure the activities of more powerful actors (e.g., rural communities, farmers, indigenous populations); on the other hand, the actors perpetrating the grab can be domestic and foreign companies or investment groups, local-international investors alliances, or government-investors alliance (Dell'Angelo *et al.*, 2018). As regard the motives driving land and water grabbing, answers are multiple and include growing concerns over energy security issues and the development of alternative energy sources (renewables); national governments that are increasingly seeking and relying on private (both foreign and domestic) investments; and reforms in the water and energy sector which enhance privatisation and deregulation processes (Metha *et al.*, 2012). What is more, some countries are experiencing high levels of water scarcity, with a level of water withdrawals exceeding the per capita level of internal renewable flows. This pushes them to look for more secure water provisions abroad. Additionally, for some countries, it might be more profitable to grab land abroad rather than acquire it nationally (Rulli *et al*., 2013).

Given the previously reported data and acknowledging its relevance in the grab of water resources, it seems interesting to analyse the water-related impacts of the renewable energy sector and the water grabbing practices linked to it. As previously stated, this sector has not been affected by the pandemics as the others. Foreign investments trends towards renewables present a slight decline with respect to pre-pandemic levels, while the drop is much worse for every other sector related to sustainable development. Renewable energy sources include hydropower, solar power, wind power, marine energy, biomass, and biofuels, and are presented as alternatives to fossil fuels. They play a key role in the reduction of global greenhouse gas emissions, in the diversification of energy provision, and in reducing the dependency over the volatile and unreliable markets of fossil fuels (Ciucci, 2021). According to the 2021 fDi report, renewable energy sector has outdone coal, oil and gas for quantity of inflowing FDI (figure 2.6) (fDi, 2021). Despite a slight decline, the sector still attracts more capital than any other sector, mobilizing, in 2020, $101 billion in FDI (*ibid*). Solar and wind drive this investments trends and classify as the first recipient sectors, followed by biomass power and hydropower.

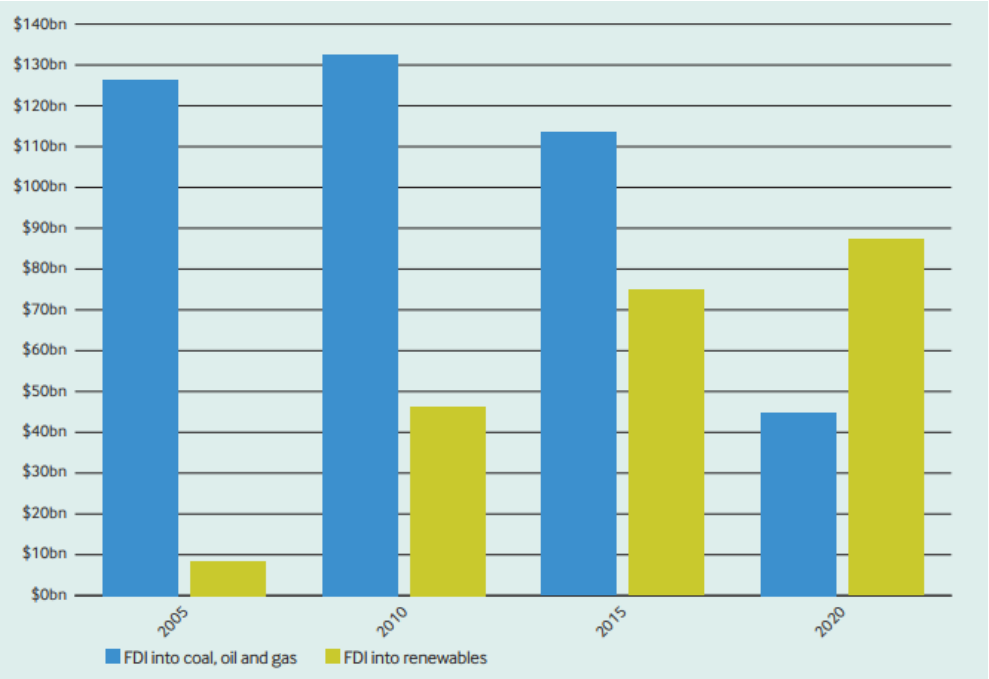


Figure 2.6: Paradigm shift: FDI switches to renewables from oil and gas in 2020. Source: fDi Markets (fDi) (2021).

As exposed in chapter one, water and energy are strongly interconnected, but this nexus is often underestimated. Water use and management in the energy sector can be problematic: on one hand, using too much water to produce energy may lead to increased water scarcity and lowered availability for other uses and users; on the other hand, increasing too much energy production to respond to a growing water demand may increase emissions and lead to black-outs, paralysing entire sectors (Bompan and Iannelli, 2018). What is more, water and energy themselves entail a complex relation with another global issue: food security. With the current outstanding population growth, which is increasing demand for food, water, and energy, the link between these three sectors is increasingly concerning policy makers (UN, 2021).

The following sections will thus focus on water grabbing practices in the realm of energy production, especially as regard the development of renewables. Solar and wind will not be taken into consideration, as their water impacts are very low, while oceanic energy use is not spread. Contrarily, hydropower and biofuels are largely used, water-demanding sources of energies and thus fit better the scope of this research.

2.4. Agriculture-driven water grabbing in the renewable energy sector: the role of FDI in biofuels production

The promotion of private investments by local governments can be a great spur for unsustainable water resources use. This seems particularly true in the case of agriculture. In this regard, scholars studied extensively the global rush for land and the phenomenon of Large-Scale Land Acquisitions (LSLAs)[3], especially after the 2008 food crisis. Many countries in that period clashed with the unreliability of sources of food: major exporting economies such as Russia, Indonesia, and Argentina restricted their exports due to increasing food prices. This decision hit hard on import-dependent economies, which started to invest in large-scale land deals, targeting mainly regions with high yield potential, but low exploitation levels, due to low technological skills (Rulli and D'Odorico, 2014). This entailed an increasing attention of corporations towards land investments, which outputs (e.g., food, fibre, and biofuels) could represent worthy payoffs (*ibid*). What is more, some fast-growing countries, which are also important global players, such as China, India, and Arab countries are experiencing resources constraints within national borders, especially for land and water, and thus try to respond to internal demand by seeking opportunities abroad (Bossio *et al.*, 2012). However, a social-environmental assessment of the effects of a change in land use from small-holders and subsistence farming to large-scale intensive agriculture are often overlooked.

While some studies praise the positive effects of these land deals, stressing the improvements in national agricultural economic independence, other researchers emphasise the environmental, social, and economic disruptive effects of this rush, including water grabbing, displacements of rural populations, and negative impacts on local livelihoods (Mechiche-Alami *et al.*, 2019). Other studies place themselves in the middle of these two opposite positions and report the controversial nature of these deals: Rulli and D'Odorico (2014) estimated that LSLAs, which are mainly directed towards developing countries, could significantly improve malnutrition levels in host countries, feeding up to 300-550 million people; however, they also notice how this is far from happening, as usually the food produced in the acquired land is exported. Scholars addressing the negative effects of LSLAs commonly agree in defining these deals as *land grabbing* practices and rise ethical problems such as human rights violations, dispossession of the commons, environmental disruption, and power inequalities among stakeholders in land deals negotiations (Dell'Angelo *et al.*, 2017).

When grabbing land for agriculture, it is frequent that perpetrating actors are also grabbing the water resources offered by the area, both surface and groundwater ones. Indeed, as stated before

[3] LSLA refer to the practice of leasing or selling land of over 200 hectares in size to governments or companies (Mechiche-Alami *et al.*, 2019)

(CH1), agriculture is rated as the main consumer of freshwater resources. Grabbed lands are normally used by companies which start intensive monocropping cultures. Most of these enterprises are convinced that the risks are reduced by acquiring a land which is close to a reservoir of water, as this can represent a guarantee for future agricultural production (Olanya, 2012). Following this reasoning, some scholars even hypothesised that FDI towards large-scale land acquisitions may be driven by water, rather than land needs. Water, as broadly discussed in Chapter One, is indeed a core resource to economic and social development of rural and industrial societies. That of increasing food production while taking into consideration the several competing uses of water resources is an always greater problem for agriculture. Agricultural withdrawals regard both green and blue water, depending on the type of irrigation used for the acquired land, which can be rainfed or need irrigation and water infrastructures. When acquiring new lands, enterprises are also gaining access to both green and blue water resources in that area (Dell'Angelo *et al.*, 2017). Intensive agriculture has proven to be a burden for land, as it promotes soil degradation and sterilization, this way leading to an always growing need for water to irrigate and maintain high productivity in those lands. In this regard, also the choice of the type of crop is relevant, as the water required varies according to the type of plantation. A rise in water demand also causes worsening rates of groundwater pollution and overextraction, and triggers demand for hydraulic infrastructures as dams and canals, prised by common narratives for pushing agricultural development, without accounting for social-environmental impacts (*ibid*). Figure 2.7 presents the level of water stress caused by the agricultural sector. It seems that agriculture withdrawals are a particular concern for water stress levels in countries which report an already high level of water stress, such as Central Asia, the Middle East, Western Asia, and Northern Africa (FAO, 2021).

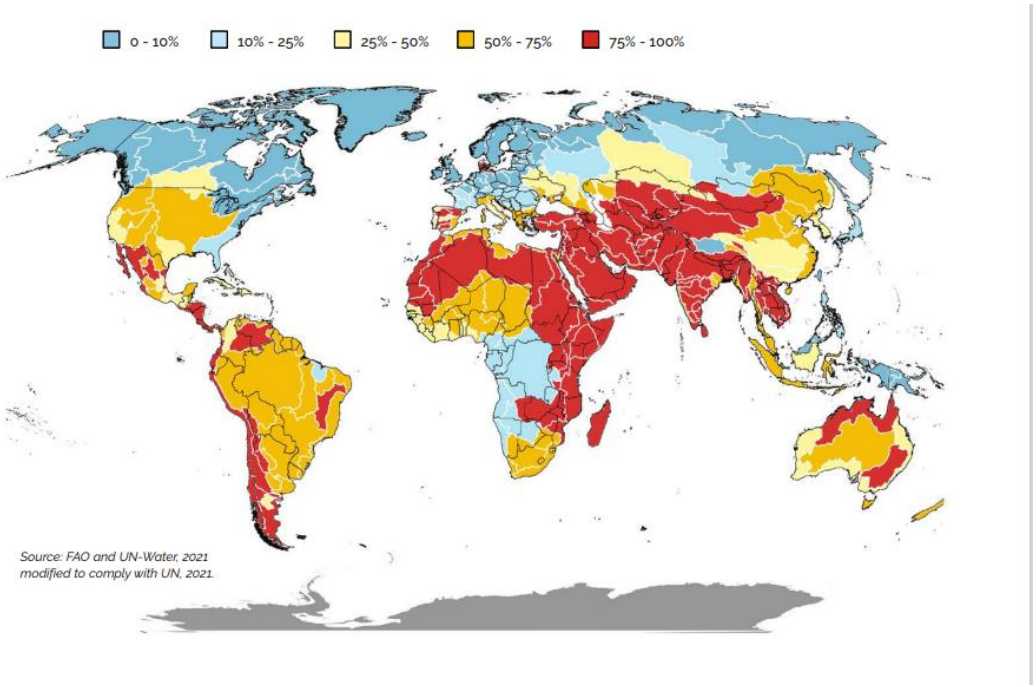


Figure 2.7: Level of water stress due to the agricultural sector by basin, 2018. Source: FAO (2021)

Intensive agriculture is not a process which can be related only to food production. Indeed, recently large portions of land are being sold and used to meet an emerging trend which sees new demand for crops which will be transformed into biofuels. The production of biofuels sharply increased in developing countries to respond to an increase in the demand for renewable energy of developed economies (Selfa *et al.*, 2014). Biofuels can be of different types and serve different scopes; examples can be agriculture and forestry residues, biomass, sugar, and oil, which can be proceeded into energy sources used in heat, electricity, and transport services, such as biodiesel, bio-oil, and bioethanol (Msangi *et al.*, 2008).

Biofuel is labelled as a renewable energy, mainly because it is obtained from plants and its exhaustion only happens if retarding the plants' growth (Takeuchi *et al.*, 2018). Biofuel is also believed to increase energy security levels of the country where it is produced and to improve equality in access to energy, thanks to its even distribution (this is in comparison with fossil fuels). Additionally, biofuels can be considered as a blessing for the economy, especially in developing countries, because they increase agricultural profit (of major importance in low-income, agriculture-driven economies), employment rates, and agricultural exports. These are among the principal causes which recently led many governments to attract these kinds of investments in national lands (*ibid*).

However, when deepening the analysis, a much more complex frame appears. Despite being promoted as a 'green' and renewable source of energy, biofuels present some negative sides, especially with regard to water use. Biofuels require high amounts of water to be produced, as they

need it both in the phase of the plants' growth and in the transformation process (figure 2.8). Generally, water use for biofuels is especially high in the agricultural production phase, but water consumption might stem from chemical pollution and transforming processes (ActionAid, 2015). Biorefineries, for instance, require more water than chemical refineries for hydrocarbons (which, not to forget, are reported as the most water-consuming energy source) (Bompan e Iannelli, 2018). The most water-demanding crops are maize, sugar cane and oil palm, while others, such as jatropha and pongamia, can grow even in dryer lands (*ibid*). This obviously is no good news in the light of water scarcity and unsustainable water use in agriculture. What is more, it might be the case for some projects that the initial predicted water use does not reflect the actual use. This happens frequently when projects only account for green water, namely rainfall, but end up using additional water to maintain high yields. Unfortunately, these variances from the original project take place especially when the area is under water stress and in competition with other users and uses (Franco *et al.*, 2013).

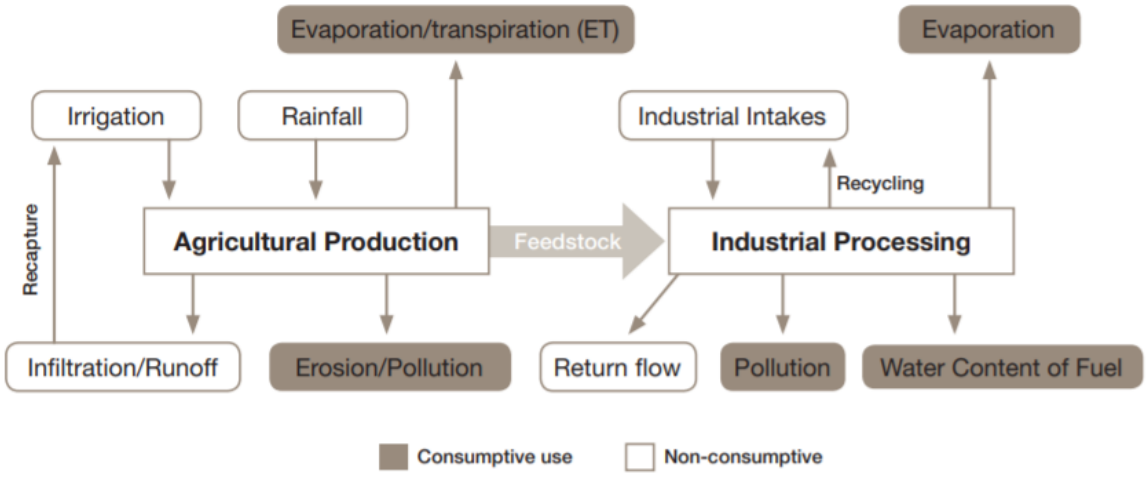


Figure 2.8: Schematic of water uses in the biofuels life cycle. Flows of water both into and out of the bioenergy production and processing system are represented. Source: ActionAid (2015)

The Colombian case (Box 1) is a typical example of agriculture-driven water grabbing for biofuels production. What seems relevant is not just the *quantity* of water demanded by the sector; water *quality* is concerningly affected, too. Economic incentives for agricultural production may lead to excessive use of fertilizers and chemicals (Takeuchi *et al.*, 2018), which penetrate the land or are directly discharged in waterways, polluting water resources, and affecting water quality, this way limiting water accessibility to local and downstream populations. Agriculture is among the major sources of water pollution, together with urbanization and industry. An analysis by sector established that about 2250 km^3/year of sewage are discharged into the environment. Yearly, urban users discharge about 330 km3, industries 660 km^3, and the highest share is hold by agriculture, which

releases into the environment about 1260 km^3 per year (FAO, 2021). Pesticides are cause of major concerns, especially for water quality, as scholars recognize the growing inability of soils to degrade these harmful substances: high levels of nitrogen, salinity, and biological oxygen demand are frequently found in freshwater resources (*ibid*).

What is more, biofuels can compete with other sectors, such as food, industrial resources, and natural conservation, demanding for the same land and water resources (Stoeglehner, 2009). In low-income countries, where food and/or water scarcity are real problems, these kinds of activities may compete with national strategies for food self-sufficiency.

At the global level, the amount of water available would be enough to produce both food and biofuels. However, from the regional and national perspectives, in countries where water quality and quantity are already poor, the production of biofuels may exacerbate already existing problems. In water-scarce regions, more than 90% of water use is associated to irrigation practices in agriculture (Duda, 2017). Many people in the agriculture sector rely on aquifers. Globally, there are about 300 transboundary aquifers, and these should be a reliable source for the 2 billion people depending on groundwater withdrawals (UN, 2021a). Excessive water extraction in such a situation is probable to create of further tensions among communities and states which already suffer from a scarce water supply.

BOX 1: Bioenergy crops-driven water grabbing in Valle del Cauca, Colombia

The case of Colombia seems interesting to understand the problems which a sugar cane plantation can cause on water resources availability. In the Valle del Cauca, sugar mills grabbed aquifers and rivers' water. About 3000 km^3 of potable water are withdrawn each year to irrigate sugar cane plantations in the region (Selfa *et al.*,2014). The social and environmental effects are concerning, with problems of salinization, contamination, and environmental conflicts among small producers and households (*ibid*).

The use of water in the Valle del Cauca increased sharply due to growing production of sugarcane. The government played a key role in managing this renewed source of demand, supporting sugar mills through unequal distribution of water concessions for underground water (sugar industry got the highest share – 88% - compared with household, agriculture, and other industries) and lowering rates for surface water use. Additionally, sugar industry and refineries producing ethanol are major water polluters: the Cauca River is polluted with pesticides, nitrogen, and phosphorous, mainly deriving from sugarcane industry (*ibid*). More recently, land deals on oil palm increased significantly in Colombia, accounting at present for 33% of total land deals (Land Matrix, 2022).

This is another plantation which requires high amounts of water, negatively impacting local populations. There emerged proves of polluted water discharged into forests, unequal water permits allocation, and groundwater pollution, limiting access of rural and indigenous people to the water they previously relied on (Potter, 2020).

Through demand and pollution, sugarcane and oil palm industry in Colombia is an example which shows how water can be grabbed from previous and different uses and users. Contamination and overuse are threating water quality and access to potable water for local populations, ignoring ecosystem effects and rural and indigenous communities' water rights. Water provision for household is the more at risk: groundwater in the Valle del Cauca is deemed of high quality, but the sugar industry is pushing for the government to recognize this water as non-potable to increase the amount of water they can use for irrigation (*ibid*).

2.5. FDI in the hydropower sector: water-related implications of large dams' construction

Agriculture driven water grabbing has been and still is the most studied form of water grabbing. Yet, recently, increasing attention has been focused on other activities of water depletion, related to food, water, energy, climate, and mining (Metha *et al.,* 2012). In some cases, water can be the direct object of grabbing. FDI addressed towards the hydropower sector, for instance, directly affect water resources, through the capture and privatization of river bodies and water reallocation to private powerful actors. This situation differs from agriculture-driven water grabbing, where the main objective of FDI flows and connected grabbing practices is the land. Hydropower, as biofuels, is labelled as a 'green' source of energy, yet, when analysing the impacts it has on water resources, water-related sectors, and equal and sustainable development, its status seems to waver.

Hydropower uses the fall of water at high speed to generate power, which is made possible thanks to dams. The building of dam is not recent history, but the development they experienced since the 1950s is remarkable (World Commission on Dams, 2000). Dams can be used for different purposes, from water storage and withdrawals for irrigation or urban supply, to hydropower, navigation, and food protection (WWF, 2013). Even though irrigation seems to hold the highest share of water withdrawals from dams, due to the increase in food demand, hydropower is expanding at relevant rates. Today, there are about 60,000 large dams in the world and the number of planned and under construction projects exceeds 3,700; only one-third of the world's longest rivers have not been dammed and thus flow freely (Lovgren, 2019)

Hydropower produces today 16 % of global energy and it is the third largest source of energy, after coal and natural gas (IEA, 2021). Hydro projects development had a great spur since 1970s, especially in emerging economies. Here, hydropower can be a key player in improving water services, energy security and economic development (World Energy Council, 2016). In these countries, currently, it is Chinese investments which lead the hydropower sector's development. According to the link above, "Over half of all new hydropower projects in sub-Saharan Africa, Southeast Asia and Latin America through 2030 are set to be either built, financed, partially financed or owned by Chinese firms." (IEA, 2021, p.10). Chinese investments are directed mainly towards sub-Saharan Africa, where with Chinese support is allowing for the African largest dam project to be built: the Grand Ethiopian Renaissance Dam. In Asia, Chinese investments account for 45% of total hydropower investments and in Latin America more than 40% of hydropower project see the Chinese participation. Other relevant players in the sector are Norwegian, South Korean, Thai, and Iranian companies, both private and public (World Energy Council, 2016). Even though, historically, investments in the sector were mainly public, recently new actors emerged as key players. These include national banks, especially those of China, Brazil, Thailand, and India, but also private banks, equity firms, export credit agencies, and regional development banks, stipulating new private-public alliances (Franco *et al.*, 2014; World Energy Council, 2016).

Dams are reported to bring several benefits, because they are, highly efficient, cheap, and renewable sources of energy (Franco *et al.*, 2014). What is more, some projects can reduce the risks from flooding and drought, supply drinking water, improve irrigation, provide touristic services and thus new sources of income, and improve employment rates, both during e after the construction (World Energy Council, 2016). However, the construction of a dam also presents relevant downturns. There exist social, economic, and environmental negative impacts, which should be taken into consideration when analysing overall sustainability of such large-scale projects.

Today, only few of the largest world's rivers can be deemed 'free-flowing', meaning no dam has been built along the riverbed. These include Amazon, Congo, Irrawaddy, and Salween rivers. However, these rivers are in danger of losing this status if the current proposed hydropower projects are to be realized (Thieme *et al.*, 2021). This is a problem also for smaller-size river. In Europe there seems to be a real rush for damming in the Balkan region. In what is also named the 'blue heart' of Europe, there are about 3,400 new hydropower plants projects being considered (Lovgren, 2021). There is scientific concern over this trend. Rivers flowing freely can provide several benefits, such as food provision, sediment delivery (important for agriculture), drought and floods mitigation, and biodiversity protection (Lovgren, 2019). However, the ability of rivers to deliver these ecosystem

services is linked to their natural flow regimes. A great reproach to dam projects is precisely that of negatively affecting the biodiversity of the river. Dams can fragment the river, alter its flow, inundate the surrounding habitat, damage biodiversity, and affect the transport of sediment and nutrient towards the delta (Thieme *et al.*, 2021). This is why some scholars believe hydropower might be a renewable resource but condemn the label of 'green' energy source. In this sense, some scholars even raise doubts over the climatic impacts of these projects, contesting the idea that dams are low-impacting and showing concerns over dams' greenhouse gas emissions (*ibid*). Environmentally speaking, dams are especially problematic to fisheries, as they block their migration routes and their reproduction. In some cases, the aquatic habitat alterations led to a sensible reduction of stock fish and, in more dramatic cases, even to the risk of extinction of some species. The most dramatic cases are reported for the US salmon, the Chinese paddlefish, and the Irrawaddy Dolphin population in the Mekong River.

This is from the environmental point of view. More troubles emerge when taking into consideration also the socio-economic perspective. The environmental impacts listed before directly affect people which rely on the river, its biodiversity, and its rhythm, for daily subsistence. Today, about 2 million people directly depend on rivers for the provision of drinking water, fish caught (globally, an estimated 12 million tonnes per year) feed and sustain tens of millions of people, 25% of the global food production depend on irrigation from river, and the river deltas, which can only be maintained through river sediments, host about 500 million people (Opperman, 2018).

In the river deltas, the situation is particularly concerning. Sediments play a crucial role in limiting coastal flooding, today a growing threat for costal populations, especially due to climate change. However, most deltas, and especially those highly inhabited, are located at the end of the largest rivers, which, as stated before, are also the most heavily dammed (Edmonds *et al.*, 2020). With dams impeding the flow of sediments towards the delta, the risk of flooding increase and so thus the vulnerability of delta populations. About 25 million people live in deltas with poor sediments and higher risk of floods, and they are concentrated in developing and least developed countries (*ibid*).

Beyond the sediment impediments, another social-impacting effect of damming rivers is that of reducing fish stocks. As stated before, a dam can represent an obstacle for fish migration, trapping fishes and blocking their route, but this is not the only concern. What is more, dams along a river influence the timing of floods by holding water when there is high availability and realising it during the dry season. Due to the complex nature of water, the effects of such an artificial change are quite complex and trigger a domino effect. Indeed, changing the rhythm of the river also means to disrupt the ecosystem which those precise fluctuations had created. Fishes struggle to find food and must

adapt to an altered habitat (Richter *et al.*, 2010). This reduces overall fish stock, and it negatively affects riverine population which relied on the river flooding times for the horticulture and fish caught which provided them with food and small income for basic daily subsistence (*ibid*). These effects, which alter both water quality and quantity, hit hard riverine populations, composed mainly by the rural poor (*ibid*).

Thus, it appears clear that, when building a dam, consequences are to be measured also kilometres away from the project's location. Once the dam is built, problems of communication emerge, as upstream decisions (on water holdings, for instance), impact populations downstream. However, the very first and most evident negative impacts of large dam projects remain in the very spot where the dam was built. Relocation of local communities is among the most problematic effects. According to data, about 40 to 80 million people had to leave their former residence because of the construction of a dam (Thieme *et al.*, 2021). The promises of benefits and compensations to offset the troubles of a relocation are rarely met by the companies leading the projects or prove not to be enough to regain an at least equal standard of living as before the displacement (World Commission on Dams, 2000). It is indeed rare that the beneficiaries of a dam project will be the people more closely affected by its construction (Richter *et al.*, 2010). Relocations are especially problematic as they can also entail human rights violations (Box 2).

Additionally, water rights (formal and informal) and benefits of use are reallocated to powerful players in hydropower projects. In Brazil, for instance, the energy provided by the hydro project of Belo Monte was unequally distributed among users, as large transnational companies engaged in the mining and metallurgic sectors and supermarkets accessed energy at much lower price than population. Likewise, in the Democratic Republic of Congo, Inga 1 and 2 dams along the Congo River account for 85% of overall energy provision in the country; however, 90% of the population lack access to energy services, as most of the provision goes to relevant economic sectors, such as the mining industry (Franco *et al.*, 2014). What is more, the project for Inga 3 provides for the selling of generated energy to other countries, namely South Africa (Rieu-Clarke, 2015).

Another problem raised by overly damming a river is that of creating tensions among different stakeholders, thus promoting social and geopolitical conflicts. Transboundary lakes and rivers are 263, and overexploitation, degradation, and pollution of water can trigger local and international conflicts (UN, 2021a).

BOX 2: Dams and indigenous rights in the Philippines

Hydropower development in the Philippines has always triggered social tensions, especially from indigenous people, and is now drawing attention to the marginalization of these people. These social groups have been opposing large scale infrastructures aimed at damming river for hydropower generation for more than 50 years (Lapniten, 2021). There is high risk, in the region, that large dam projects will violate indigenous people's rights over water and land resources, as well as jeopardize their livelihoods (Talamayan, 2020). While these projects are enthusiastically embraced by local élites, which prise these investments and their role in the country's development process, indigenous people who live along (and depend upon) the river and its flow are mobilizing to halt them.

The Jalaur River Multi-Purpose Project Phase II (JRMPP) is a case in point. The dam is located in Calinog, Iloilo (Philippines). Works started in 2019 and the building of the dam begun in June 2021. Being an expensive and highly impacting (both socially and environmentally) project, it may be deemed a 'mega-dam'; however, the intention of investments is for irrigation of nearby farmlands and power generation seems low (6.6 megawatts), compared to the economic, social, and environmental costs (EJA, 2015). The major investor is Daewoo Engineering and Construction, a South Korean company. National spendings for the dam amount to $216.7 million, and the flooded area hosts about 80 species of flora and fauna which will feel the effect of a changing habitat. What is more, the flood will displace at least 600 households, excluding from the count affected populations downstream (Talamayan, 2020). Of great concern are the effects on the *Tumanduk*, the indigenous population settled in the area. This indigenous population has been forced to accept $977 per hectare, and even less for those in lack of a Certificate of Ancestral Domain Title (Land Matrix, 2021).

Negative impacts will be several. Environmentally, air pollution, biodiversity loss, floods, food insecurity, aesthetic degradation, surface and groundwater depletion and pollution, are just some examples. From the socio-economic perspective, increased corruption, displacement, loss of livelihood, and violations of human rights are possible negative consequences of this mega-dam. Additionally, negative impacts are expected also in social health, including mental problems (stress, suicide, alcoholism, …) and malnutrition (EJA, 2015). These problems are mainly affecting local and riverine populations, which will endure another great problem, namely the loss of cultural heritage, as villages, farms, ancestral land, and their burial sites will be flooded (Land Matrix, 2021). Despite the social mobilization and resistance from local communities, and the scientific warnings on the questionable 'pro-development' narratives, the construction of the Jalaur Dam is ongoing.

CHAPTER 3

WATER GRABBING: DRIVERS AND POLITICAL FLAWS

In chapter two, the main features of water grabbing were discussed, both generally and for the renewables sectors. The chapter reported the major impacts of such practices, especially as regard water reallocation and its consequences for basic human rights and the right to water. Water is indeed diverted to new uses and users affecting both local and downstream communities, which access to water sources is threatened. Consequently, conflicts spread, and tensions increase among and within countries. The fact that water bodies are often shared by different states furtherly complicates international relations and water diplomacy, urging for enhanced cooperation. What is more, water grabbing practices may increase the marginalisation of farmers, which see their wells drying up, and cause the displacements of entire communities. Compensation for these negative externalities is rarely enough and equivalent to the ceded land, but poor farmers have weak bargaining power in these negotiations and their rights are rarely considered, if recognized. Even when formally recognised, it is frequent to witness changes and reformulations of previous legislation on uses and withdrawals of the resource, in favour of more powerful actors. The present chapter will thus focus on the mechanism allowing for water grabbing practices to continue, including the use of narrative which justify such behaviours and inefficient international and national policies of water allocation. Possible responses will be then presents, including social mobilization. The last part will focus on the renewables sector and the water-food-energy nexus as a possible alternative and more efficient response.

3.1. Narratives and drivers of water grabbing

Water grabbing practices are of complex nature. They can be perpetrated by several different actors, from the public or private realm. Private companies, national banks, local governments, business elites, and international banks can all be involved in the current transformation and privatisation of water bodies and resources, upon which weaker actor previously relied for their livelihoods. Practices of dispossession are brought about by these and several other actors, at the expense of the poorest. Dispossession relates not only to the physical water grab, but also to nullification of these people's rights to water. The access to the resource, which they've enjoyed for centuries, are swept away by these "grabbers". This usually happen in the name of 'development'. Indeed, water grabbing appears justified by dominant narratives, which in many cases are supported by the national governments themselves. In the previous chapter the main driver and actors perpetrating the misuse of water resource at the expense of rural and urban poor were presented. We will now turn the attention towards how these practices are legitimated. Narratives are of major

importance when dealing with resources grabs, although sometimes underestimated. Water grabbing practices, for instance, are justified by narratives of unused land and water resources and of scarcity needs (Metha *et al.*, 2012, Scoones *et al*., 2019). After the 2008 food crisis, overseas investments increased towards resources abroad, especially to get a more secure source of food and energy, which were growing scarcer in many developed, import-dependent, economies (CH2). The 'scarcity' narrative was precisely what legitimised land and water grabs and dispossessions. It was indeed the spreading of such narratives which in part made it possible for foreign companies, governments, and national and international financial actors to access and control national resources, triggering reallocation processes which are often based on power imbalances (Scoones *et al.*, 2019). The outcomes of these reallocation processes often result in weaker actors (such as the rural poor and marginalised people) losing their land and water access and forced to relocate, with promises of compensation that rarely are enough (if they are even met).

A dominant narrative justifying resource grabs is the need to respond to an imminent crisis. The crisis to which these narratives refer are several. For instance, the problems raised by the need to feed a population which is currently growing at unprecedent rates. For international organizations, foreign and national investors, and the actors of the agri-business, large-scale investments of the entity we discussed in chapter two are a plausible solution to respond to the increasing demand for food (*ibid*). Another narrative which supports these investments is that of climate change and the need to reduce global greenhouse gas emissions. As we saw before, this is a narrative which justifies many large-scale investments in the biofuel and hydropower sectors. From the investors' point of view, the brightest side of these investments is indeed their ability to reduced emissions, substituting more polluting energy sources, such as fossil fuels. Narratives linked to these sectors argue for a sustainable, clean economic development. In the case of dam building, this narrative created the 'hydropower myth', prising economic, social and environmental benefits, while concealing relevant negative externalities and arguable cost-benefit analysis (Williams, 2019). Interestingly, this is the same narrative used by local communities, NGOs and other players to counter large-scale investments, perceived by these actors as threats to economic, social, and environmental stability and to overall sustainable development.

A further dominant narrative for resource grabs is abundance and underuse. Investors justify their action by deeming the resources they grab wated and unutilised before they took control. In this sense, investors become the ones able to fully exploit the potential of resources, this way triggering the famous process of 'development'. This is especially true in the case of land and water grabs, as private and national actors consider these two resources as wasted, if not used for irrigation or in food

and energy production (Metha *et al.*, 2012). Yet, this is a contested narrative. Indeed, previous users seem not to be considered in the land and water use evaluation. Remaining in the shade, these weaker actors are not involved in the negotiation processes, which proceeds as they did not exist. As a consequence, this narrative justifies national governments to displace local and indigenous populations, allowing for the reallocation of their rights to use water towards more powerful actors.

Another successful narrative justifying resource grabbing is technological development. Investments from foreign companies are praised to improve local knowledge by promoting technological advance. Relying on technology could represent, according to investors, a way to systematically increase production, this way reducing the threats posed by food, water, and energy scarcity (Scoones *et al.*, 2019). Technological investments in land above all are pointed by many as the solution to scarcity problems. However, this technological optimism lacks a deeper analysis of the direction of technological development and its outcomes (*ibid*).

Lastly, narratives of shared and mutual gains are frequent justifications for resource grabs. The idea brought about is that investments in resources can represent win-win solutions, satisfying both the investor and the host economy. Large-scale deals on land and water may be deemed arguable under some perspectives, but they can provide opportunities, too. Typical positive effects preached by international organization, investors and the agri-business are technological spill overs, development, and higher productivity.

Political narratives as the ones described above, justify large scale investments by private actors in natural resources, including land and water. In the case of water, for instance, these narratives legitimise the intervention of private actors in irrigation, remarking that private investments are more efficient than public funds in managing water use (Franco *et al.*, 2013). That of efficiency is indeed a narrative which international actors, such as multilateral and regional banks, use to justify their support for deregulation and privatisation measures (*ibid*).

Narratives play a relevant role in legitimising water grabbing practices. However, it is primarily local institutions and national governments which can be held responsible for allowing these controversial practices. Since the 1990s, free trade agreements and bilateral investment treaties have been providing foreign investors with tools to avoid national regulations and to contest national laws in front of international tribunals, if they felt their interests and profits were harmed (Franco *et al.*, 2013). What is more, national governments often tend not to enforce regulations protecting human rights and the environment.

Another relevant narrative is that of water as an economic good. Since water has been labelled an 'economic good' in the 1992 Dublin Statement (chapter one), the aptitude towards the resource has changed (Franco *et al.*, 2013). The proposal of giving to water an economic value must be understood in the light of the broader neoliberal turn of the late 1970s, when governments take a more detached approach to national needs, taking less responsibilities for the needs of the poor and marginalised fractions of populations, and rather operating through liberalisation and deregulation. This inevitably affected water governance, affected by policy decisions of deregulation and privatisation, pushed by the economic liberalisation wave and structural adjustment processes. This new idea of water drove a new approach toward the resource, strongly backing water management through economic principles. This historical path led to today's episodes of privatisation. Yet now, privatisation regards not only the water sector, but also the resource itself. Rivers, lakes, and aquifers are being privatised and controlled by powerful actors, and we also assist to the financialisaton of water, as water becomes a traded good. This narrative puts in the shade the cultural and social values of the resource, prioritising its economic value and acting as powerful drivers of water grabbing practices,

In this context, the international realm seems not able to provide a clear and univocal framework for water resource management, providing further support to resource grabs. Grabbers take advantage of the fuzzy legal context to attain the best outcome from land and water deals (Metha *et al.*, 2012). The greatest attempt to regulate and improve water administration has been made through the Integrated Water Resource Management (IWRM). IWRM is defined as 'a process that promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.' (UNEP, 2022). The process aims at substituting the traditional fragmented approach used by policymakers to address water management issues, in favour of a more integrated perspective, which recognises water as part of an ecosystem, a natural resource, and a social and economic good.

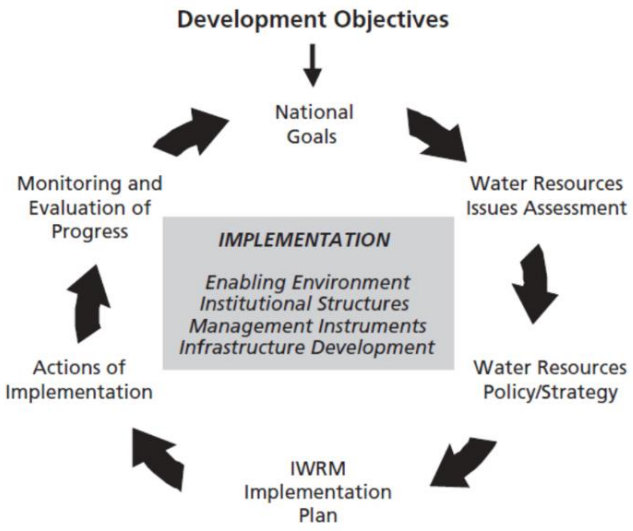


Figure 3.1: stages in IWRM planning and implementation. Source: UN (2014)

However, as appear from the definition, the process is unclear and ambiguous, leaving space for interpretation. IWRM can thus become a liability for the promotion of a sustainable water use. The broad scope of the process, which yearns for economic, social, and environmental sustainability of the water sector, is exploited by powerful actors to legitimise their actions (Franco *et al.*, 2013). In this sense, IWRM-based water reforms can also imply the easing of water grabbing practices. This happens mainly through the decentralisation of water management and the licensing of water abstraction (*ibid*). Decentralisation is a consequence of an attempt to improve participation in water decisions, shifting control from administrative units to water management bodies related to hydrographical boundaries. However, this process implies the identification of water users and bearer of water rights. In several cases, this excludes the informal users not recognized by law, thus favouring foreigners' participation, dispossession processes, and the resource grabbing. Water permits, established through water licencing, present similar issues. Permits are of central importance in IWRM application, but they tend to neglect former practices of water sharing and control. These former informal decisions were made by local communities but cannot be immediately legalised under formal legislation (and sometimes they intentionally left out). The consequence is a process of 'dispossession through licencing', common in today's resource grabbing practices, which aims at the eviction of former, legally unrecognized, rural water users (*ibid*, p.1665). Thus, it is frequent to witness disregard towards already existing small-scale users and uses, such as smallholders using water to drink or irrigate small areas. Water grabbing practices are favoured by these omissions, as they are justified to bypass the involvement of local communities in the decision-making process. As will be discussed later, social movements can represent a key instrument to hamper large-scale

investments threatening local communities; neglecting former users and uses of a resource thus represents a great advantage for grabbers.

Another key driver of water grabbing practices is the growing influence that multinational enterprises have on water management. The private intervention in water management, especially in irrigation processes, is backed by powerful international organisations, such as the World Bank. Through narratives telling a story of inefficient local water management and infrastructures' maintenance, the organisation calls for a growing role of management and finance in water management (Houdret, 2012). These private-public partnerships entail different levels of involvement in the resource control. Often, actors seal a 'built-operate-transfer' contract, where the private actor manages the infrastructure and the linked operations only for a certain amount of time (*ibid*). Thus, these increasingly powerful actors are usually not involved in the above-mentioned process of privatization; rather, they influence water management practices as they often are the major users of water. This is the case for transnational corporations in the food, beverage, crops, and services sectors.

Beyond withdrawing large amounts of water, these companies are also more and more interested in the management of the resource and the protection of their access to it, as this becomes scarcer. Water stress is perceived as a risk by many corporations, which keep water management as a core issue in their agendas, developing water specific politics, strategies, and plans (European Commission, 2011). The water demand coming from these large companies often clashes with demand from other uses and users. For instance, water demand from agri-business can conflict with demand from local farmers; oil and mining sectors use and pollute large volumes of water, this way limiting access to potable water for local and downstream communities; the beverage sector is another water-demanding sectors, with big names such as Coca-Cola, PepsiCo, Nestlé, and Unilever at the centre of attention for limiting access of water to local communities to pursue their private interests (Hall and Lobina, 2012). These companies usually resort to narratives of water efficiency and reduced water footprint to diminish the actual impact of their activity on the society and the environment. Indeed, transnational corporations are also active in trying to influence the global debate on water resource management. To make their interests prevail, these actors act through groups of companies. An example is the 2030 Water Resources Group, which aims, mainly through reports publications, at influencing water management at the basin scale and promotes the involvement of companies in decision making over water allocation (Franco *et al.*, 2013; Hall and Lobina, 2012). Another grouping is that derived from a UN initiative, the UN CEO Water Mandate, endorsed by 210 companies. The mandate recognizes that companies impact water resources through goods production. Yet, this approach fails to consider social and environmental consequences of water mismanagement (Hall and

Lobina, 2012). Other water-related organisation where private actors play a key role are Aqueduct and the Water Footprint Network, both measuring water impacts of business actors. However, these initiatives are based on a technical and economic ideology, which emphasizes the economic value of water. These increasing initiatives of transnational corporations, aiming at influencing water policies, can affect water grabbing practices. The major risk is that of influencing policies towards the reallocation of water resources under an economic approach, which overlooks food and water security of local communities and the soundness of the environment and ecosystems (Franco *et al.*, 2013). There are, here, two conflicting approaches to water resources, resulting in a clash of cultures, the first one perceiving water as sacred and addressing its preservation as a duty; the second one prising the commodification of the resource and its transformation into an object of trade, and treating it as a corporate right (Shiva, 2002).

There is, however, a common thread linking these drivers. For each case, the role of local institutions appears of central importance in driving water grabbing practices of reallocation and misuse of water resources by powerful actors. Indeed, it is often local and national governments which ease and support these practices, reframing existing rules which should hamper the grab and taking advantage of legislative gap (Metha *et al.*, 2012). Thus, local governments often avoid requiring environmental impact assessments of the projects and omit consulting local communities. What is more, new coalitions of interests are emerging. Governments show interest on large-scale investments, and it can happen that bureaucrats collaborate with private actors to accomplish private interests. Additionally, sometimes water rights do not exist per se, and are included in broader land rights, creating a situation in which water rights are not recognized, let alone regulated. Also, local specificities can facilitate water grabbing practices. When people enduring the grab are poor and vulnerable, they are keener to accept low compensations for their land and the associated water resources. What is more, corruption dominate in developing countries' local institutions, thus making it easier for foreign companies to acquire local water rights (Metha *et al.*, 2012). Analysing the several difficulties in the water management sector appears pivotal to better understand how policymakers behave and why some political decisions may reveal themselves inadequate, this way hindering equitable access to water resources.

3.2. Water: a private or public good? The role of state and market in the water sector

The role of markets and states in water services in developing countries is highly debated. The scarcity issue and the competition among uses and users make the management of the resource and its allocation very complex. Water, as largely discussed previously, is different from other finite

natural resources, such as oil, coal, crops, and timber. The allocation of these resources is usually a result of their trade in market, but when dealing with water, this market approach may reveal itself inefficient and trigger unequal allocation (White, 2015). Thus, there are two major conflicting approaches to water management: one calling for the privatisation of the resource, reducing at the bare minimum the role of the state, the other sustaining the need for water to remain a public good and supporting the idea that the privatisation of the resource would be a violation of the human right to water. The latter is the position usually undertaken by civil society groups. In a neoliberal perspective, the privatisation of the water and sanitation sector could overcome state inefficiencies in water management in developing countries (Baer, 2014). However, this position is highly debated, as the consequences of a privatised water sector appear controversial. Instead of ameliorating previous public policies, privatisation in several cases entailed rate hikes, water quality degradation, limits of access to poor consumers, and increased corruption (*ibid*). What is more, human rights defender advocate against privatisation processes, claiming that the state is the primary actor in pursuing human rights and limiting its sphere of action would not allow the protection of human rights and the human right to water.

Public water management in developing countries is problematic. The outstanding increment of global population experienced in the last decades implied some changes in the water sector and in water services management. Indeed, because of population growth, it was reported that households lacking access to piped water experienced a twofold increase in their water use rate, while where piped water was available problems of service reliability emerged (Koundouri *et al.*, 2013). The increase reported mainly regarded health and hygienic uses of water, such as cleaning, drinking, eating and personal hygiene. However, the growing demand challenges provision's efficiency, forcing poor households to store water. Coupled with a poor hygiene education, this situation can represent a threat to health, becoming a key vector of diseases such as malaria and dengue. Some help to improve the water sector in developing countries arrives from international community; yet, as discussed in chapter one and two, investments in the sector are not enough to adequately improve the current situation and rather showed, in some cases, counterproductive. In the aftermath of WWII, development aid from developed towards developing countries increased. This aid came in the form of financial flows, but not only that. In many cases, it involved the transplantation of technologies from richer to poorer economies (Koundouri *et al.*, 2003). However, this process did not necessarily ensure that benefits would trickle down to poorer countries. In fact, there is who sustains that this transplant of technologies is the reason why some economies today are trapped in a poverty condition (Allen, 2011). If technological progress and industrialization triggered development in rich countries, the same was not true for developing ones. Western economies' path towards development was

marked by an increase in wages, which led to the necessity of reducing labour costs. As a consequence, labour-saving technologies were introduced, which allowed for higher productivity and increased wages. The fact that poorer economies did not undertook this same path is pivotal in trying to understand their missed growth. Indeed, while western countries found it profitable to invest in labour-saving activities, due to increasing wages, developing countries, where wages were low relative to the cost of capital, there was no economic incentive in investing in labour-saving technologies (*ibid*). As regard water, development aid towards the sector often involved technological transfer, thus presenting several controversies. For these investments to be successful, different conditions should be met, such as positive local responses, capital availability (both for the project and the interlinked activities) the presence in loco of skilled workers, the provision of adequate maintenance, etc. (Kounouri *et al.,* 2003). Developing countries strive to build a stable and reliable water sector and their struggle is furthered by high costs, low and poor investments, and infrastructure maintenance. Indeed, even when investments arrive, sustainability remains hard to achieve. About 30% to 50% of water projects fail after only two to five years, and generally projects struggle to bring the expected benefits, especially in the long run (UNDESA, 2015)

With a growing population and these technical issues to solve, developing countries lag in providing widespread and reliable access to clean water, especially for the poor and marginalised fractions of population. To face these growing challenges, developing countries need large amounts of capital, which were not slow in coming. As introduced before, since the 1992 Dublin Declaration water management undertake a neoliberal-influenced path. Beside policies of integrated participation and water rights formalisation under national law, that period marked a shift towards privatisation and deregulation of the sector, prised as the solutions to state failures in water management (Franco *et al.*, 2013; Baer, 2014). A new, market-oriented approach to the water sector emerged, which looked at water as a private resource and an economic good. The role of private actors acquired importance and private water operators emerged as big players. Governments delegated managerial responsibilities to these actors through concessions, triggering a process of commodification of the resource. Usually, this does not imply a full privatisation; indeed, the private sector can be involved in water management practices at different scales, through concession and leases at a smaller scale. The water sector is still largely public, but since the Dublin watershed water consumers in the Global South buying water from private European water operators were reported to increase by 800% (Baer, 2014). This turn towards privatisation raised several concerns (Box 3).

Box 3: Water privatisation and water rights in Chile

Chile is considered as a successful example of water privatisation. Under a privatised water supply system, the country is believed to reach well-performing levels of drinking water and sanitation coverage (Baer, 2014). However, the relationship among a private system and water rights is sparking a debate on whether this measure is efficient or not in sustainably managing water resources.

Water management appears of primary importance in Chile. Indeed, the country is one of the most affected by climate change and it is included among the 30 countries with highest water stress (FCH, 2019). Recently, this emerged as a concerning issue, raising concerns on water rights and their management. The 1981 Water Code signed the beginning of water privatisation in Chile, following the lead of neoliberal reforms. Initially, this appeared as a successful story. The success, however, was mainly linked to the strong influence the state had in the water sector despite its privatisation, rather than to the privatisation per se (Baer, 2014). Yet, in recent times, the system has been criticised for the increasing number of slums which lack access to safe water, not to the mention the water-related consequences of the boom in the avocado production, especially in the northern part of the country. As a consequence of the climate crisis and the growing scarcity of the resource, the private system and relate water rights allocation to private actors, are being criticised, as more and more people are cut-off from water provision. Chile still presents high rates of access to drinking water in urban areas; however, this does not reflect the several protests spreading across the country and asking for a rethinking of the system. Looking at the Gini coefficient in relation to water resources, the situation today appears as highly unequal, ranging from 0.83 to 0.97[4] (Correa-Parra *et al.*, 2020). The use of water rights as private assets in the market is thus believed to negatively affect accessibility to natural resources, as it is cause of social marginalisation, especially for the rural poor and low-income social groups (*ibid*). The sustainability in the long run of the Chilean fully private water system is thus more and more contested.

3.2.1. The role of the market and market failures

Today, we assist to the privatisation and financialisaton not only of the sector, but also of the resource itself. Water is a complex matter. It is treated as a *private good*, but it also is recognized as human right. Water presents two main features of private goods: it is excludable and rivalrous. The

[4] The Gini coefficient is used to measure inequality in the distribution of a given factor among the population. Results are included between 0 and 1, where 0 represents total equality and 1 complete inequality (Correa-Parra *et al.*, 2020)

former refers to the ability of producers to determine access to the good based on the consumer's willingness to pay, while the latter indicate that the use of the resource by a consumer reduces overall availability for other users. In this sense, water is treated as tradable and subject to market rules. However, at the same time, water is also a human right. In allocating water resources, trade-offs between the two uses should be considered. A daily per capita provision of about 50 to 100 litres is deemed enough to satisfy the basic human right to water; consequently, any additional use of the resource may be best allocated through market mechanisms (White, 2015). As pointed out by White (2015), water is not as other traded goods (Figure 3.2). Usually, when a consumer values equally two goods, he or she perceives one good can be substituted by the other. This is not the case for water, which cannot be substituted by any other good until the per capita daily basic provision is fulfilled (point A in the figure). However, once the basic need has been met, water is perceived as tradable and substitutable by other goods (point B in the figure) (*ibid*).

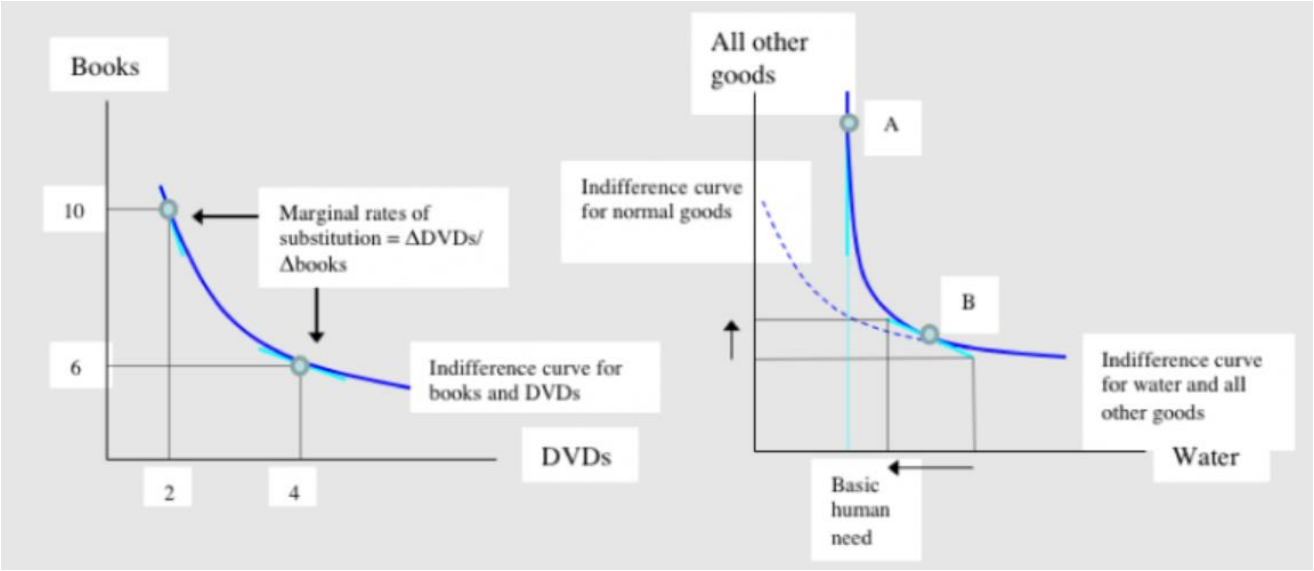


Figure 3.2.: Indifference curves for water versus other goods. Source: White (2015)

Besides being a private good, water is also a *common-pool resource* (*ibid*). Water, as stated before, is hardly regulated by property rights. When lacking property rights, a resource is considered as an open access resource. When resources are both rival, so the use by one actor reduces availability for other consumers, and non-excludable, so the users are unable to avoid paying a considerable cost, overuse is willing to occur. Consumers are allowed to withdraw as much water as they need, with no further consideration on other uses and users. This obviously can have negative impacts on water allocation. In a competitive market, when the market price offsets supply against demand there is efficient allocation. This may be the case when the cost of an additional withdrawals is equal, or lower, than the benefits of withdrawing that additional unit. However, being water such a complex

resource, the costs to the users are difficult to account for. Indeed, there are external impacts of water withdrawals which are not included in the final market price and thus are not considered by the user while operating (e.g., when withdrawals from one user reduces water availability for crops, fisheries, or biodiversity). An efficient water allocation would thus consider both private and external costs, but the open access character of some water resources prevent this from happening, leading to water overuse and undervaluation.

However, water use can also have positive externalities, including improved health and development. Usually, this is the case for water infrastructures. These benefits can, even though it is hardly the case for water, be excludable, so that only the consumers pay for the resource's use. In this case, water is considered as a *club good* (*ibid*). More often, these benefits are non-rival and non-excludable, making water a *public good* (*ibid*). In the case of hydropower, for instance, an increased number of consumers does not affect overall water availability for other users, and people cannot avoid benefitting from a reduced flooding risk. While in the case of club goods, regulations make it easier to exert control over the resource's use by private firms, in the case of public goods it is more convenient for private firms to wait for other actors to provide the service. Indeed, in this case, it is frequent for the 'free rider problem' to emerge. The free rider has few incentives to contribute, as it can anyway benefit from the other actor's service (for the principle of non-excludability). As a consequence, the provider of the service will not be adequately compensated.

Thus, while in the case of private and club goods firms benefit from the goods' provision, this is not true for public goods. Their features of non-rivalry and non-excludability entail higher risks for market failures[5]. These happen when the market produces an outcome that is not socially desirable, that is, it is not optimal for society, but it is for the single economic agent. In the case of *public goods*, individuals may try to maximise their benefits from the public good, and in response everyone in the market will suffer from a reduced supply. Thus, in the case of water, private markets may prove inadequate to correctly and efficiently allocate and provide water services (*ibid*).

Externalities are an additional possible form of market failure (FAO, 1993). They present themselves when the activity of one agent has consequences on others, even if not involved in the activity. These externalities can be positive (i.e., reduced flood risks) or negative (i.e., the effect of saltwater intrusion downstream as a consequence of water withdrawals or flow deviations).

[5] Market failures emerge "when incentives offered to individuals or firms encourage behaviour that does not meet efficiency criteria or, more generally, because efficiency or economic criteria fail to satisfy national social welfare objectives." (FAO, 1993).

What is more, *natural monopolies* another form of market failure which commonly emerge in the water sector (*ibid*). They present themselves when the bigger supplier in the market, or the first supplier in the local place, have great cost advantages (Nauges and van den Berg, 2007). This situation is frequent where there exist barriers to entry, mainly deriving from high capital costs for industries in that market. The first or larger company in the market can make decisions which affect the price of the resource. For instance, it could under-price new entrants or decide to impose high costs on the consumers (FAO, 1993). This is a market failure which frequently affects projects of water supply, dams, and canals for irrigation.

Another market failure which could negatively impact water allocation is the Principal Agent Problem. This is a problem which emerges from *information asymmetry*. In the exchange of goods, people engage in a relationship if there is an incentive to do so, and this depend on demand, supply, and price-related decisions (Huppert, 2002). What is more, this relationship should be based on both accountability and transparency (*ibid*). However, these are rare in circumstances of service delivery, when the consumer does not know for sure how the provider will act (indeed, the service cannot be inspected before it is provided). This is an information asymmetry, which can be exploited by the service provider (e.g., the 'agent') to achieve his best interests, even if contrary to those of the consumer (e.g., the 'principal'). Moral hazard is thus frequent in these situations, as the agent, aware of the principal's weakness, can take more risks, knowing it will be someone else bearing the consequences. What is more, frequently the costs of overcoming this asymmetry, maybe hiring a different provider at an advanced stage of the project, are too high to undertake (*ibid*).

For water to be efficiently allocated, the complex nature of the resource and the several uses and users it serves must be taken into consideration. Strong institutions are with no doubt the leading actors towards this direction. Indeed, be it privatised or public, for the water sector to be managed in compliance with the right to water, a strong state role is needed (Baer, 2014).

3.2.2. Water mismanagement and local institutions: governmental failures

The role of local institutions in managing resources is pivotal. Many economies rely on natural resources as their main source of income, especially in the developing world. Several scholars argue for the importance of *quality* of institutions to determine whether an abundance (or scarcity) of resources will transform into blessing or a curse for economic development (Badia-Mirò *et al*., 2015). As such, the economic failure of resource-based development in many developing countries can be traced back to two factors. Firstly, an inefficient and unsustainable management of natural resources,

which generated little additional economic rents; and secondly, the inability to reinvest the generated rents into more productive and dynamic sectors, ultimately tiggering growth-enhancing structural change (Barbier, 2015). This is true also in the case of water resources management, and even more considering that water is a growingly scarce resource. The scarcity of the resource makes efficiency of water allocation policies pivotal for sustainable and equal water management. Indeed, especially where water runs low, allocation may lead to conflicts between sectors, regions, communities, and individuals. In such circumstances, water policies directly impact income and livelihoods (Houdret, 2012). In this sense, water allocation entails not only an economic interest, but also socio-political relations and games of power. The political agenda is an important driver for water grabbing practices, as decision makers try to support the elite's interests and the stability of their office. In this way, water allocation can become a driver of marginalisation and social inequality (*ibid*). Self-seeking behaviours are one of a series of *government failures* which can drive water grabbing. Government failures present themselves when governments do not pursue the public interests. In the case of self-seeking bureaucrats, decision makers act in order to pursue their own interests, like any other individual, rather than optimizing the impacts on society.

Another government failure is rent seeking. This can be a good example of institutional water mismanagement. It is defined as "the process of seeking income and advantages that are not matched by labor or investment in the productive sense." (Renger, 2002). Powerful actors lobby regulatory bodies to reap rent. The ways in which rent-seekers gather rent from rent-providers are several, including "submitting, following, profiling, making oneself important and indispensable, soliciting, networking, passing on incorrect or distorted information, suppressing information, and frequently also bribing decision-makers" (*ibid*, p.52). institutional lobbying is frequent when dealing with natural resources allocation: individuals, companies, and social or interest groups all try to influence policymakers deciding on the allocation or on the rights to use. Government irrigation projects are, for instance, the perfect target for rent seekers. Institutions are responsible for rents allocation, including land, water, and services (*ibid*). In this situation, powerful actors, such as the agri-business and large landowners, lobby institutions and try to capture the resources allocated by the state. Through the manipulation of natural resources allocation, these actors aim at gaining financial benefits. However, their primary goal is that of achieving their own interests, without generating benefits for the society. As a consequence, these practices are believed to be deleterious both for the economic growth and social development. The role of institutions is crucial in easing rent-seeking behaviours, especially in developing countries. Here, institutional features favouring such practices include decision making processes, which are not transparent; complex bureaucracy; absence controlling and monitoring bodies; lack of a defined separation between legislative, executive and

judiciary powers; legal uncertainty; poor democracy; and large information asymmetries between actors (*ibid*). In such an environment, decision-makers consider more important to ensure their political survival and gain political support from powerful social group, rather than do good for the population. That of rent-seeking is a concerning issue especially in societies where we find different ethnic, religious or family groups. Indeed, it is easier in these cases for rent seekers to take advantage of the conflictual relationships among these groups over rents. What is more, these groups may engage closely with bureaucrats or even be part of the government, which is the most effective way to collect rents from natural resources allocation.

Regulatory capture is another great problem linked to water mismanagement. This form of state failure takes place when institutional agents design norms to meet the interests of the groups they are regulating, rather than those of the society (Rudra *et al.*, 2018). When dealing with water resources, governments rarely find it profitable to strictly regulate transnational corporations or create a situation that will force them to leave. Indeed, there are several benefits they can gain from MNCs presence within national borders, including increased employment rate, economic growth, and political supports from powerful elites which support FDI. What is more, MNCs have the ability to influence government regulations, through information, resources, and organizational advantages (*ibid*). Regulatory capture is a much severe problem in developing countries. Here, regulatory bodies lack skilled employees and adequate laws to respond effectively to problems of implementation, accountability, commitment, and efficiency (Rudra *et al.*, 2018). This negatively impacts economic growth. Indeed, it has been reported that the independence of regulatory institutions from external interference is of great importance for the country to undertake the path of economic development (Kirkpatrick, 2014).

That of government failures is often used as an argument supporting privatisation and the minimisation of the role of the state. However, in the case of water, the private or public approach to the resource management does not impact the importance of state intervention. Indeed, to comply with an efficient and sustainable water management, the role of a strong state is not only desirable, but also necessary, even when the sector has been privatised (Baer, 2014).

3.3. Responses

Access to clean water is, in many cases, a political, rather than physical issue. As reported in chapter one, there would be enough water in the world to for all users and uses, but the way the resource is being managed makes it growingly scarce and precious. Water grabbing practices,

favoured by distorted narratives, market failures, and government failures, put further pressure on the resource availability. This is a serious problem, especially in developing countries.

First, a possible response to water grabbing practices is that of reframing the current dominant narratives. Scholars are trying to produce new vocabularies and to shape new ideas that will contrast water grabber justifications. Above all, they are attempting to challenge the idea of unused land and wasted water resources. Indeed, it is important to recognise previous users and their rights. Small farmers, indigenous communities, and local population all live off land and water resources, which they locally manage through informal rules. This obviously make the dominant narratives of abandoned land and trapped potential inconsistent (Metha *et al.*, 2012).

That of recognising previous land and water users, which usually are the rural poor, is also pivotal in the fight for poverty reduction (UNDESA, 2015). The efficient allocation of water resources, in this sense, is not only a way to counter water grabbing practices, but it acquires a key role also in reframing the importance of the poor and marginalised population's interests. Sometimes social groups are excluded from water access, as in urban slums, where dwellers need to pay high prices in the informal market to get water (UNDESA, 2015). The Water Governance Facility reports that:

"Most vulnerable in a world of greater water insecurity are poor people living in informal urban settlements and those in rural areas whose livelihoods are dependent upon rainfed agriculture or the availability of grasslands and water for grazing animals. Protecting the rights of such people and avoiding elite capture of the resource and the benefits derived from it require tools that facilitate a more equitable allocation of scarce water resources."

(WGF, 2012, p.8)

How water is allocated, as stated before, is mainly a matter of political choices: be it private or public, water management needs strong and efficient institutions to comply with requirements of sustainability and equality (Baer, 2014). Pro-poor water regulation appears as a strong response to water grabbing. It entails securing a reliable access to water for production and assuring access to adequate quality water and to the services it provides (Schreiner, 2010). History of water resource management shows how, initially, infrastructures such as pipelines, pumps, dams, and boreholes, played a key role in development, improving water provision in time and space. However, limits to supply are sooner or later reached (*ibid*). As this happens several supply-side solutions can be adopted to reduce shortage risks, including increased water storage, groundwater development, water recycling and reuse, pollution control, and inter-basin transfer and desalination (FAO, 2012). However, these solutions may require high capital investments, and supply may ultimately be

hindered by financial limits. When the supply limit is approached, it appears fundamental to improve water regulation. This includes controlling who uses water, who is deteriorating its quality and how, and the protection of the resource (Schreiner, 2010). What is more, poverty can be an obstacle to sustainable water management. It can promote pollution and misuse and make investments inefficient because local household struggle in financing, operating, and maintaining water infrastructures (UNDESA, 2015). Indeed, as stated before, even when water sector is financed, long-term sustainability is not granted. Also in this case, institutional failures, such as the inability (or unwillingness) to monitor, collect fees, or gather information, seem a key driver.

Poverty-oriented efforts should focus on access to water for productive uses, from agricultural to industrial and accounting also for ecosystem services. Yet in the water sector this allocation is often unequal. Basing our idea of development on the human approach proposed by Amartya Sen, development should be multidimensional and people-cantered, and it should focus on individuals expanding their freedoms, choices, and opportunities (UNDESA, 2015). However, this may be hard to achieve in water allocation practices. This is a constraint for overall economic development. Pro-poor policies in the water sector can directly impact sustainable development, benefitting the economy, the society, and the environment, also in the long run (UNDESA, 2015). Efficient water management and allocation can promote sustainable development by improving four aspects of poverty: livelihood security, health risks, vulnerability, and economic growth. It is important for poor people to improve their ability to live off the resources they have, to reach acceptable living conditions. Water access can support fishing activities, cattle, aquaculture, and horticulture, ultimately improving lifestyles. Furthermore, increased water accessibility can reduce the risks of contracting water-related diseases such as diarrhoea and malaria, which are common causes of death in developing countries, especially among children. Reducing vulnerability is another pro-poor action, consisting in mitigating the impacts of environmental threats, such as flood and droughts, and in fighting against volatile and unstable prices and politics. Lastly, economic growth cannot be the only driver of water allocation. Investments in the sector can benefit the economy in several ways, but it is of central importance that decision making take into consideration environmental and social impacts and need to be implanted alongside smaller investments in irrigation, power generation, crop diversification, and market and institutional improvements (UNDESA, 2015). Targeting gender equality is another policy which could have great impacts on water access and water management. Globally, women account for 37% of agricultural workforce and they constitute 50% workforce of small-scale cattle farms and fisheries (FAO, 2021). However, they rarely are included in water-related decision making. Less than 50 countries have a regulatory body which mentions the role of women in sanitation and water management (*ibid*). This is not only a matter of social injustice and inequality,

but it also represents a burden for efficiency, given the wide knowledge and skills of women in water management (UNDP, 2006). What is more, reducing the time used for providing water could have important impacts for the lives of women and children, especially young girls, including lowering mortality rate, improving school attendance, education, and employment rates (UNDESA, 2015).

However, the local level is not the only 'scale' which should be addressed when reasoning on water management. Indeed, another response to challenge water grabbing can be that of water governance. The OECD defines water governance as the "range of political, institutional and administrative rules, practices and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision makers are held accountable for water management" (OECD, 2015).

Water grabbing is set in an environment which is characterised by the coexistence of different regulatory frameworks and processes determining the rights to use water, which water resource can be accessed and for what purposes (Franco *et al.*, 2013). In recent times, we are experiencing a shift from 'government' to 'governance', which requires a system based on a multi-level and multi-actor approach. This approach calls for the active participation of all stakeholders involved in the water sector, including international, national, and local actors. This means not only national governments and policymakers, but also citizens, private actors, end users, investment banks, and infrastructure and service providers (OECD, 2011). This integrated participation in decision making could represent a valid way to address the complexity of the water sector, thus challenging one of the main drivers of water grabbing practices and poor water allocation. However, water governance appears as a complex issue, challenged by several factors, including fragmented institutions, low capabilities at the local level, unclear roles of management, inefficient resource allocation, and weak regulations (OECD, 2011). In developing countries these constraints are amplified, as people are still attached to local and informal institution, and customary practices (Unver and Mansur, 2019). Here, integrated water management has been proposed, especially from international actors, as a possible solution to water misuse. Yet, there is still no evidence of implementation in practice (*ibid*). Examples of international standards proposed include the IWRM, which main features and flaws has been presented before; the nexus approach, a similar program focusing on links among water users (e.g. among food, water and energy, as will be discussed in Chapter 4); and the Agenda for Sustainable Development, pointing out the interrelated character of the 17 SDGs (in the case of water, for instance, SDG 6 on water and sanitation can be linked to SDG 2 for ending hunger and SDG 15, which aims at improving life on land an soil quality) (*ibid*).

Furthermore, the involvement of the international community in order to improve water management practices can be detected in the increasing importance of transboundary water management and water diplomacy. Overexploitation and degradation of water resources can cause social tensions and trigger conflicts, especially as climate change concerns and demand increase. A supranational and integrated approach to transboundary water management, through better legal and institutional frameworks and shared benefits and costs, appears fundamental to address past and new challenges in the water sector (UN Water, 2021). The need for cooperation emerges especially for water-demanding sectors, such as agriculture, industry, energy, navigation, and water supply and sanitation (*ibid*). Action in one of these sectors can impact local communities, but the effects are perceived also beyond the national borders. Thus, it is important, through a supranational approach, to act taking into consideration economic, social, and environmental effects at the local and transnational level. Some steps towards transboundary water management have been takes, with 295 international water agreements since 1948 (i.e., the UNECE Water convention). However, there still is much to do, as about two-thirds of transboundary rivers are not regulated by any cooperation agreement (*ibid*).

The governance approach highlights the importance of all stakeholder's involvement in water management to comply with sustainability and equity goals in the sector. Beside local institutions and the international community, a third actor should be considered: the civil society. Indeed, mobilisation from below is an increasingly efficient tool to promote sustainable water management and counter water allocation inefficiencies and water grabbing practices (Metha *et al.*, 2010). Social movements and pressures can act as a deterrent for regulatory capture and rent seeking behaviours, promoting the adoption of a stricter and more people-oriented legal framework. Policy makers may thus reinforce regulations, even if this counters their own interests or those of powerful élites, in order not to lose the citizens' support (Rudra *et al.*, 2018). As a matter of fact, government failures are more frequent in contexts where the population is mainly composed by poor and marginalise people. In this scenario, political engagement is low, and so is population's political influence. Indeed, these people are believed to lack a formally recognised legal identity, wealth, knowledge, and political skills and are thus more easily caught into vote-buying (Rudra *et al.*, 2018). This contributes to the formation of a favourable and permissive environment for MNCs and water grabbing practices (Franco *et al.*, 2013).

When dealing with water resources, the negative impacts of FDI on water quality and accessibility are not countered in high poverty and inequality nations, where protests are too weak to fight the lobbies of the business sector (*ibid*). However, it also is true that where the population is able to organise in a collective and sustained manner to challenge authorities and powerful groups, and their

practices, important results can be achieved (Box 4). Despite dominant narratives of weak and vulnerable local users, there are several examples of social mobilization against environmental injustice and natural resources exploitation, even in the water realm. Responses to grabbing practices from below can be both violent or non-violent; what is more, they range from local to national, and even reach the transnational level (i.e., the global water justice movement and the European movement "Right2Water") (Dell'Angelo *et al.,* 2017). Today, there is a shared opinion on the importance of local people's involvement in water management. Following the call to a more integrated approach to water management, the involvement of local communities has been increasing. However, involvement is still far from 'empowerment' (UNDP, 2006). Changes in water management have been directed towards giving more voice to water users, rather than empowering them with rights. As such, small-scale users might get more voice in decision making, but the old unequal power relations persist (*ibid*). Small users thus remain weak in comparison to large-scale business companies, and unable to make their interests prevail.

To sum up, in order to challenge current pressures derived from climate change, increased water demand, changing diets, and urbanisation, great efforts are needed. Above all, these should be channelled towards institutional strengthening, information collection, and infrastructure development (World Bank, 2022). Possible political tools to reach the goal of a more sustainable and equitable management of the water sector are regulatory frameworks, water pricing, and incentives. These institutional tools may be relevant in the promotion of improved water allocation, regulation, and conservation (*ibid*). However, institutions are not the only players. The supranational and local level should engage more in water management. This approach, addressed as 'water governance', recognise the important role of each stakeholder involved. The global water governance regime which is emerging can be defined as plural-legal and stretches from dam movements to international frameworks such as the IWRM (Franco *et al.,* 2013).

Internationally, legal frameworks can propose a code of conduct which is globally accepted. What is more, governance would allow to deal with the time and space complexities of water, calling for the need of international cooperation and diplomacy among nations sharing the same sources of water (i.e., aquifers, rivers, and lakes). Another relevant step to take is that of adopting a people-oriented, rather than market-oriented approach. Discourses about water grabbing practices bring out the controversial and debated role of economic growth and development narratives, pointing out the need for a stricter regulation of water exploitation, capital flows, and unjust reallocation and dispossession (Metha *et al.,* 2012). Social unrest is an increasingly important tool to counter such practices. Bringing

back to the centre the role of local communities in water management appears as a fundamental step to promote sustainable water management and to fight misuse and bad water allocation. Recognising the role of local population would mean to challenge the existing unequal power relation which so strongly and resiliently characterise the water sector.

Equitable access to water is pivotal to oppose rural poverty, as sustainable resource management is closely linked to policies of poverty reduction. To implement effective water policies, countries will have to aim at better-conceived regulations, improve access and elaboration of information, improve skills and capacity, and take into consideration all the different stakeholders in water resource allocation and management (OECD, 2015).

Box 4: The Blue Heart of Europe – Mobilisation from below in the Balkans

There are few free-flowing rivers in world. In Europe. This high fragmentation is excreting unprecedent pressure on lakes and rivers. Common fragmentation practices include dams, canalisations, and bank reinforcements (DG Environment, 2021). Recently, we are witnessing an increasing recognition of the deleterious effect this situation has on the environment and society. The European Commission is lobbying states to remove obsolete barriers to comply with the goal of restoring 25000 km of free-flowing rivers (*ibid*). However, there is still much to do, and future forecasts are not so bright. The Balkan region hosts the last uncontaminated rivers of the European continent, which is why it gained the name of 'Blue Heart' of Europe. The region aquatic system appears particularly healthy, especially in relation to the rest of European water bodies. However, it is being subject to what appears as a race for dams. Today, dams and deviation in the region are about 1000, and more than 3000 are planned or under construction (Patagonia, 2021). These dams are expected to create irreversible damages to both local communities and the environment.

Local communities are strongly affected, too. Yet, the Balkan region seems particularly active in social mobilisation. "The brave women of Kruščica" are an example of what a powerful tool protesting movements can be to counter water grabbing. These women occupied the bridge of the Kruščica River, in Bosnia and Herzegovina, for 500 days and nights. They resisted forced eviction by the police and struggled through winter, winning the fight against the construction of two hydropower plants (Stielow and Wieser, 2021). The group was awarded the Goldman Environmental Prize, amounting to $200.000. In a three-year time, this is the second time the prize is awarded to Balkan activists against hydropower. Other examples of active social mobilisation against dam building have been reported in Macedonia, Serbia, and Kosovo (Ranocchiari, 2019).

A particularly concerning case in the Balkan region is that of the Vjosa River. This is the last free-flowing river of Europe. Its bed stretches uncontaminated for more than 270 km in southern Albania. But its status is under threat. Government seems to favour hydropower to more 'green' solution, such as sola power, and 38 hydroelectric power plants have been proposed. Negative impacts are expected on the ecosystem, with biodiversity loss, especially as regard fish. What is more, these projects are small for amount of energy produced (less than 10 megawatt), and this prevent them from undergoing environmental impact assessments. This is a problem which is common to the whole region, as the majority of the projects are *micro-hydro* plants.

Lack of transparency is an additional great problem. The actual government states no dam will be built on the riverbed, yet apparently it is not moving towards the cancelling of planned projects in the river's tributaries. Even here, despite the decades of suppressed activism, protesting for the environment is gaining momentum, especially among the youngest (Lovgren, 2021). The attempt of activists is that of having the Vjosa recognised as a national park, to protect its status from uncontrolled damming.

CHAPTER 4
AN INTEGRATED APPROACH TO WATER RESORCE MANAGEMNT: THE WATER-FOOD-ENERGY NEXUS IN THE CONTEXT OF RENEWABLES

A good example of integrated approach to water management is represented by the water-food-energy nexus. As stated before, water is such a complex issue that strategies and investments addressed towards the single sector might not prove enough to guarantee an efficient and sustainable management of the resource (FAO, 2021). Indeed, as water resources grow scarcer, its close interlinkages with other sectors emerge as a concerning issue for many policy makers. Above all, decision makers are concerned for the effects that water stress is having on energy and food sectors, which depend on the resource and which, together with water, support the achievement of the 17 SDGs. Water, food, and energy are of primary importance for sustainable development and poverty reduction. Insecurity is increasing in all the three domains, especially following the increased demand triggered by ongoing global changes (such as climate change, urbanisation, demographic growth, changing consumption patterns, etc.). Demand for water, energy, and food is expected to grow respectively by 30%, 45%, and 50% by 2030 (Yuan and Lo, 2020).

Thus, it appears of fundamental importance to recognise the several synergies and compromises that exist among water users and uses. Despite this, many countries still rely on a separated approach to the management and administration of these sectors (Bekchanov and Lamers, 2016). This results often in conflicting decisions. For instance, growing biofuels may improve energy supply, while increasing competition over land and water for food production. Likewise, hydropower projects may increase energy availability and water storage for irrigation, while displacing entire communities and negatively impacting the environment and downstream populations (FAO, 2021). Global changes are threatening sustainable development processes and resource security of many countries, businesses, and local populations. This inability (or unwillingness) of governments to address water, energy, and food sectors in an integrated fashion is preventing the sustainable use of growingly scarce resources for economic growth (Bekchanov and Lamers, 2016). The water-energy-food (WEF) nexus approach is increasingly perceived as a possible solution to deal with scarcities and promote sustainable development in these three crucial economic sectors (Olawuyi, 2019).

4.1. The water, energy, and food nexus

Responding to a growing demand when resources are increasingly scarce is acquiring primary importance among decision makers. The concern is deeper in the developing world. Forecasts see these countries at the heart of global economic growth in the near future, a trend which is increasing per capita income and promoting more resource-consuming lifestyles. However, there still are several people lacking access to safe and reliable sources of electricity, clean water, and nutrition, thus furtherly challenging the ability to respond to the growing demand in these sectors (*ibid*). An improved management would thus benefit food, energy, and water security.

At the heart of the WEF nexus lies the attempt to balance the several competing uses of natural resources. The connections existing among water, food, and energy are undeniable (figure 4.1). Agriculture, the most water-demanding sector, consumes water along the whole agri-food supply chain, while the energetic sector requires water both to produce and transport energy. On its side, energy is consumed both in the food and water sector. Food production, transportation, and distribution account for 30% of global energy consumption, while water demand for energy originates from pumping, lifting, collecting, transporting, and treating the resource (FAO, 2014). Additionally, climate change is negatively impacting on the Nexus sectors. Floods, droughts, and rising temperatures affecting water availability and quality, decreasing the reliability of energy production, and ruining harvests.

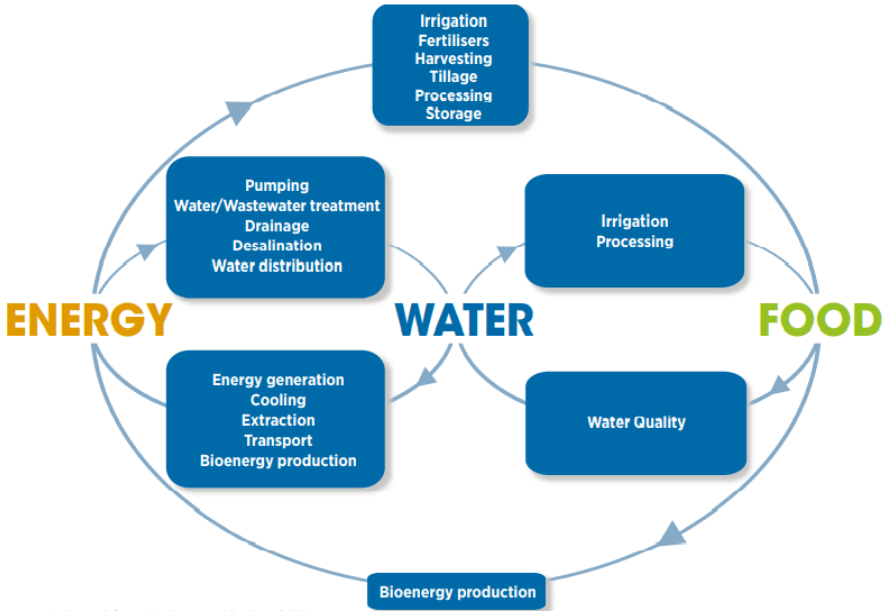


Figure 4.1: Schematic illustration of various elements of the water–energy–food nexus. Source: IRENA (2015)

The demand for the three resources is increasing from cities, industries, and other users, and the socio-environmental impacts of this trend are evident in environmental degradation, degraded livelihoods, and resource scarcity (*ibid*). These connections can play a key role in determining the achievement of three overriding policy goals, namely food, energy, and water security. The ability to comply with one of the three goals is closely linked to the performance of the others (IRENA, 2015). For instance, poor energy supply and food production can hinder access to water. The lack of a reliable source of energy limits water provisions, while intensive monocrop agriculture competes for water use with other sectors and pollutes potable water. Likewise, water and food sectors influence energy security. Water scarcity can represent an obstacle to reliable and affordable energy provision services and the needs of other sectors, including agriculture, may limit water resources towards energy production. As regards food security, this is affected by bad water allocation and energy unreliability, which can impact on both food availability and affordability (*ibid*).

The Nexus approach allows for the recognition of this complex and interlinked nature of the water, energy, and food sectors. In doing this, it aims for promoting a better management of the involved resources and supporting the cooperation among different stakeholders (FAO, 2014a). Indeed, the WEF nexus calls for the institutional and legal governance of the three sectors, taking into account their interdependencies (Olawuyi, 2019). What is more, this approach focuses on the technological, political, and legal spill overs that advancement in one sector could bring to the others and analyses the negative impacts of a lack of coordination between them (*ibid*).

Another benefit of the nexus approach is that of enhancing adaptation to climate change. The recognition of the entwined nature of water, energy, and food appears as a good tool to promote effective adaptation policies. Climate change adaptation is a top priority for policy makers all over the world. However, developing countries bear the worst consequences, as they depend on sectors which suffer badly from climate change, including agriculture, fisheries, forestry; they have limited resources and skills to respond to climate-related challenges; and their population is settled in climate-vulnerable places, such as mountains and coastal areas (Rasul and Sharma, 2015). Adaptation to climate change appears thus fundamental in these countries, but the approach is still mainly local and sectoral. The lack of coordination which characterises many policies can represent an obstacle to effective adaptation (*ibid*). Different sectors and scales need to work together in order to successfully address climate change challenges and the WEF Nexus could represent an effective approach for policymakers.

What is more, as will be thoroughly discussed later, the WEF nexus appears fundamental in the promotion of human rights, especially in the energy sector. Human rights violations happen as a

consequence of land dispossessions, forced displacements, marginalisation, poor allocation, and governmental repression, especially in the developing world (Olawuyi, 2019). An integrated approach would allow for the inclusion of social and human rights implication of each sector, thus promoting a better governance of water, energy, and food resources.

Lastly, an integrated approach to water, energy, and food management would allow for the implementation of the 17 SDGs. Indeed, SDG 6 on water and sanitation, SDG 7 on affordable and clean energy, and SDG 2 on zero hunger, would benefit greatly from an integrated approach. Consequently, considering all SDGs are interlinked, it could be said that all SDGs would ultimately be positively affected by the WEF nexus. Policymakers, also pushed by international obligations, would consider be able to look at the trade-offs and synergies among different sectors, this way promoting more efficient policies of sustainable development (*ibid*).

All things being considered, the nexus ultimately aims at proposing possible solutions to coordinate water, energy, and food sectors. These solutions, named "nexus solutions", are defined as "an intervention that would benefit more than one sector, in this context including also interventions that reduce the pressure on ecosystems (or the environment at large)" (UNECE, 2018, p.61). the UNECE (2018) identifies five categories of solutions, namely the "5 I's": institutions, information, instruments, infrastructure (and investment), and international cooperation and coordination. These categories should help policymakers in identifying the best solution. Being it an integrated approach, nexus solutions are proposed as packages which overcome the usual sectoral division, calling for a coordinated activity of different sectors and actors.

4.1.1. The Water-Energy nexus

Water and energy both play a key role in economic growth. Water is a necessary input for energy production. It is used in the extraction, transport, and processing of fossil fuels, and it also is of primary importance for cooling procedures in thermoelectric power plants. Renewables, too, are dependent on water resource. Hydropower plants exist only near water sources, biofuels need water both to grow crops and in the transformation process, and solar needs water for cooling. As a consequence, the choice of the type of technology, fuel, and water source are pivotal in determining the amount of water withdrew to produce a certain amount of energy. Energy is also an essential input for the water sector. It is needed in almost every step of water supply, including the extraction, treating, transport, discharge, and reuse of the resource.

Due to growing demand for energy, the water withdrawals of the energy sector could increase by 20%, while water consumption could reach a 85% increase (IRENA, 2015). A concerning trend regards fast-growing economies, such as China, India, and the Middle East. These are believed to be the hot spots of energy growth, but they also present low rates of per capita renewable water resources (*ibid*). A growth in the supply of energy would thus furtherly stress water resources and their availability. Energy-related water use is expected to increase as well. The growth could be triggered by the always more intensive use of water resources, which calls for technological innovations to mitigate water scarcity. Desalination and more powerful pumps are examples of energy-demanding technologies to improve or maintain water supply.

It appears than clear that the relationship between water and energy can raise concerns for different stakeholders, including governments, communities, and industries, and can represent a threat at different levels, from regional, to national and local. For instance, energy security can be at risk because of shifts in water availability and quality, which can result in decreased supply reliability, increased energy cost, and reduced outputs (*ibid*). On the other hand, water security can be under threat from unreliable access to energy, which could increase water prices; from the reallocation of water towards energy uses, negatively affecting previous users; and from water contamination following energy extraction and transformation (*ibid*). These are all factors which burden actors in different ways, at different scales.

4.1.2. The water-food nexus

The water-food nexus is mainly associated to changing patterns of water supply, especially in relation to large-scale, intensive agriculture and a growing demand for water, a limited resource, to comply with rising food demand (IRENA, 2015). Water plays a key role in the agri-food supply chain: it is involved in production, processing, distribution, and retailing. Water for irrigation is the most problematic use, as it will exacerbate competition among uses and users in already water-stressed countries. Yet, irrigation is of primary importance for food production, especially while experiencing an exponential population growth. Despite returning much of the used water to the ground, irrigation is highly problematic. Pollutants deriving from chemicals and fertilisers deteriorate both surface and groundwater quality, negatively impacting on local communities and consumers.

Another great problem is that of waste. High amounts of food are wasted, which includes an embedded waste of both water and energy resources. Indeed, every food contains a share of virtual water, meaning the water employed in its production. Globally traded agricultural products register the highest percentage of international virtual water flows (76%) (*ibid*). As explained in Chapter One,

a water scarce county could aim at adopting stress-reducing strategies. However, the international trade in the agricultural sector is more dependent on variable such as consumption, market, wealth, and policy priorities, while water seems to remain a poorly considered variable (*ibid*).

The interdependence between food and water sectors can thus exacerbate existing risks and create new ones. For instance, food security could be threatened by water supply variabilities, which may increase foo prices, and by poor quality of water, that negatively impact both the soil (causing sterilisation) and the consumers. Conversely, water security suffers from the impacts of the agricultural sector, that can reduce water availability through pollution, and from the lack of string and effective regulations over land deals, allowing for land and water grabbing practices. Additionally, food security ca be a narrative which justifies the overexploitation of freshwater resources.

4.1.3. The energy-food nexus

Energy and food nexus appears evident in the food supply chain. Indeed, energy is a core input in the plantation, processing, distribution, storage, and cooking of food (*ibid*). What is more, this nexus is at the centre of the debate on biofuels and their social, economic, an environmental sustainability. The food supply chain will probably increase its demand for energy, due to population growth and a shift in demand towards high calories food and meat, as per capita income grows. Food waste will thus probably become a greater problem in the future. Indeed, as for water, waste of food also means a waste of energy.

What is more, the demand for biofuels is increasing, especially for transport, heating, and electricity (*ibid*). The production of energy from crops inevitably rises questions on the feasibility and sustainability of such practices. Indeed, they implicate a competition with crops for food. The mismanagement of these two sectors and the lack of an integrated approach may lead to disruptive political and economic conditions (*ibid*). Energy may impact food security in several ways. For instance, overreliance on fossil fuels could lead to the inability of responding to shortages, thus increasing risks in food production. What is more, reallocation of land and resources to biofuel production may increase food prices and energy production could negatively impact local livelihoods (e.g., reducing fish stocks, as in the case of hydropower). Energy security, instead, is affected by the increase in food demand and changing consume pattern. What is more, energy provision and its quality are dependent on raw materials availability, as in the case of biofuels, where generation is closely related to crops availability and harvesting.

4.2. Challenges of implementation and flaws of the WEF Nexus

The WEF Nexus is thus addressed as an integrated approach allowing for better management of water, energy, and food, in the attempt to promote economic growth, while also reducing poverty and environmental degradation. This is a key objective for policymakers undertaking a sustainable development perspective. However, there seem to be several constraints on the Nexus application, making the whole approach a great tool on the paper, but still far from a full and efficient application.

Policymakers seem aware of the need for a better and more integrated management of water, energy, and food resources. However, legal and governance questions represent a barrier to the practical implementation of the nexus approach. The first obstacle may be represented by the conflictual relation between regulatory approaches in the three sectors (Olawuyi, 2019). The regulations promoted by the energy sector may indeed be incompatible with those promoted by the water of food sectors. This raises concerns among decisionmakers, which should find a way to coordinate different rules and goals across the sectors. For instance, the food and water sectors may support decisions promoting less energy-consuming solutions, but this may clash with the decision of the energy sector to invest in large infrastructure projects (*ibid*). The nexus approach thus requires an integration of different regulatory systems, which appears as a complex, yet not impossible, issue. The common understanding of other sectors' regulations and the design of instruments for integration are pivotal for efficiently managing the WEF sectors.

Another challenge to WEF implementation is the lack of linked rules, procedures, and obligations across sectors (*ibid*). Indeed, this condition makes it difficult to design and implement milt-scale and cross-sectoral projects and it may hider bureaucratic processes of approvals and permits. All these processes need to be linked if the WEF nexus has to be effectively adopted. The creation of a common understanding of the interconnection between water, energy, and food sectors, and the various stakeholders involved, would help policymakers to identify and deal with the coinciding and conflicting rules across the three sectors.

Furthermore, institutional operationalisation emerges as an additional limit to WEF Nexus implementation (*ibid*). Indeed, regulatory frameworks and rules are decided among and within regional and local institutions and the control of WEF projects is entitled to them. Often, in the water, energy, and food sectors, the institutional competencies are fragmented between several institutions and agencies, which may sometimes present conflicting. A process of integration would require huge efforts at the local scale, especially in expanding local skills and knowledge. Also here, spread information on the water, energy, and food nexus could play a beneficial role. Additionally, it would

help to identify the different institutions involved in the WEF sectors management, in order to detect overlapping, missing, and conflicting roles.

Lastly, limits in available resources are a great limit to the adoption of an integrated approach in the WEF sectors (*ibid*). All the previously identified obstacles need resources to be overcome, but these are usually limited and channelled towards other competing priorities. This appears especially true in the case of developing countries, which dispose of very limited financial capabilities. However, scholars support the idea that investments towards the WEF nexus, despite expensive, would allow for lower costs in the long run (*ibid*).

Beside these challenges of implementation, some scholars also identify relevant flaws in the WEF nexus. Firstly, the narratives of scarcity in the water, energy, and food sectors could become a justification for questionable appropriations and partial dispossession of previously shared commons, leading to the resource grabbing phenomenon. "Safe for whom" is thus a question which will stand at the centre of political debate, including WEF nexus discourses (Allouche *et al.*, 2015). International private actors were the first in promoting an integrated approach to WEF sectors management. The business consensus over the WEF nexus represents the first time that powerful industrial actors get together to support the "limits to growth" discourse. However, it is believed the main reason behind this widespread consensus is the recognition of the threats which limitation in the water, energy, and food sectors could cause to the stability of business actors' resource base (*ibid*). From the business perspective solutions are to be sought within the market. In this sense, the problem is that the resources lack a proper market value and defined property rights. Another approach taken is that of the public sector, which condemn the fragmented and market-oriented institutional management of the three resources. What is more, the nexus has been introduced within the narratives of securitisation, which highlight the threats for the global economy, national security, and conflicts (*ibid*).

Thus, current dominant narratives linked to the WEF nexus are based on the existence of present and future crisis, on the proposal of possible solutions to better manage the resources within a green economy framework, and on the call for an integrate approach between water, energy, and food. This narrative has a top-down character, with external interests and foreign managerial solution from the North to the South (*ibid*). Such discourse presents some flaws. A first critic may be on the idea of new approach conveyed by the nexus. There still is a blurred line between the framework of the IWRM and the WEF Nexus, making some scholars question the innovation of the concept. What is more, the nexus has been criticised for lack of engagement with the international political economy of the different sectors. There exist different regimes of governance for water, energy, and food, and

this leads to the coexistence of parallel concepts (such as the water-food-trade nexus and the energy-climate change nexus) which are influenced by very different global regimes and thus are difficult to coordinate (*ibid*). Another relevant flaw identified is that what could be deemed an international political economy concern related to access inequalities has become an issue solvable through economic and technological tools. In this sense, the narrative of securitisation diverted the perception of unequal access as the primary driver of resources scarcity. Economic incentives and technological innovations, including genetically modified organisms, automation of agriculture, and micro-irrigation, are presented as solutions to low resource availability (*ibid*). However, these measures are based on an overly optimistic assumption that an increase in production will ensure water, energy, and food security and increase their accessibility and affordability. Resource security should not be primarily based on its availability, but rather it should look at the monetary and non-monetary resources available to the population and evaluate whether they can be enough to access suitable quantities of that resource (*ibid*). Again, the problem raised is who benefits from those economic and technological interventions. With lack of adequate reallocation, it is often the poor and the actors not involved in business deals which suffer the most: they pay for their needs, while profits are collected by more powerful private actors. Thus, the overoptimistic approach of the nexus is another flaw of the project could ultimately spur resources commodification. Therefore, environmental degradation, such as biodiversity loss, and social impacts, including livelihood disruption, are not taken into consideration by policymakers.

A nexus approach is not to be condemned, but there are high risks of flaws which have to be addressed. the nexus addresses technological, market, and institutional innovation in the attempt to promote sustainability and poverty reduction. However, there is lack of direct references to politics and justice. Including these discourses would mean to investigate how the proposals for improvement in the WEF integrated management impact on poverty, the centrality of decision-making, income inequality, and water, food, and energy security (*ibid*) Pay closer attention to political economy issues appears pivotal to promote an approach which will be inclusive, transparent, and respectful of human rights.

4.3. Water-related issues in the renewables sector: is the WEF Nexus approach a possible solution?

Water in the energy sector is used primarily in four productive domains: hydropower, through the building of dams; coal, both in thermoelectric and mines; nuclear; and conventional and unconventional hydrocarbons, including gas shales and tar sands (Bompan and Iannelli, 2018). These

sectors all require large amounts of water, but not only this. Water returned to the environment after energy processing is often highly polluted, contaminating groundwater and the environment, and degrading the ecosystem. The share of renewables in the energy mix increased significantly in the last decades, and they recently dethroned fossil fuels as major sources of energy (fDi, 2021). Renewables are commonly perceived as a solution to a better use of water resources, however, even clean energies can perform as unsustainable practices, when mismanaged (IEA, 2021). This is evident, for instance, in the case of hydropower. The sector produces the 16,4% of world energy and is addressed as clean source of energy (Bompan and Iannelli, 2018). This appears coherent with the low carbon emissions, especially in relation to fossil fuels. However, remarkably, this sector is at the same time extremely water demanding, especially in relation to the amount of current generation (figure 4.2). Geothermal and solar thermal present a similar situation of low carbon emissions, but they require substantial amounts of water. Biofuels, concentrating solar power, green hydrogen production, and carbon capture are other examples of low-carbon but water-intensive technologies (IEA, 2021). Conversely, photovoltaic (PV) and, above all, wind, are reported as low-carbon energies, with a small water footprint, relative to other renewables.

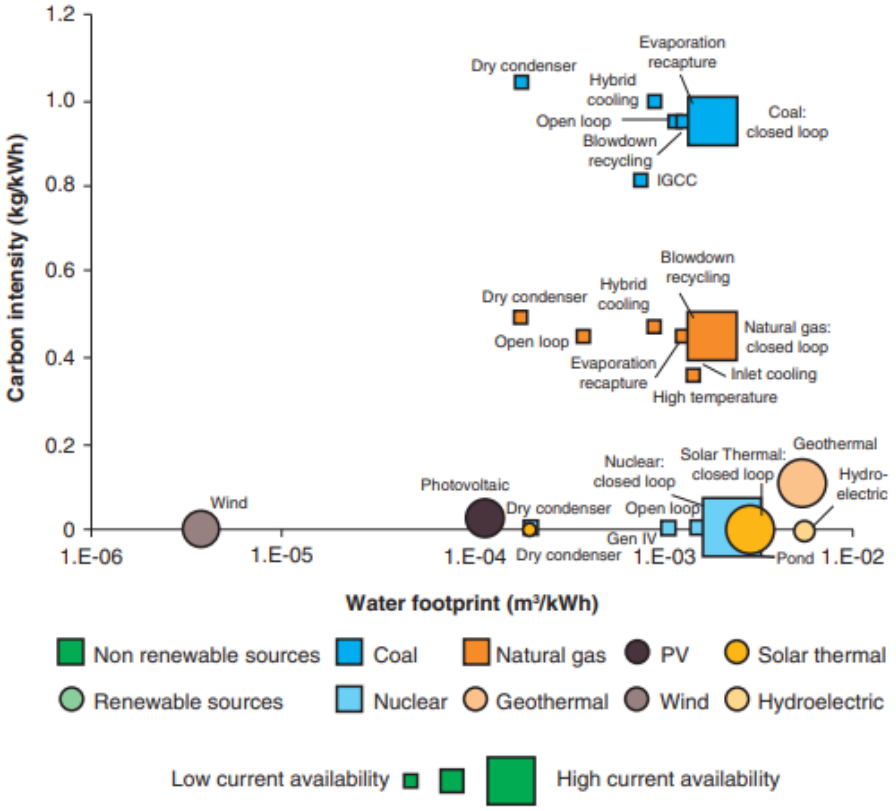


Figure 4.2: Indicative Water Footprint and Carbon Intensity of Energy Production, by Source. Source: World Bank (2016)

Renewable energies such as hydropower and biofuels perfectly represent the controversial relationship among green development and sustainable development. As already presented in Chapter Two, renewables play indeed a controversial role in the sustainable use of water, and this appears clear also through the adoption of a nexus approach to water, food, and energy.

As regards biofuels, it is estimated that 2% of water used for irrigation is finalised to biofuels (Bomapan and Iannelli, 2018). This source of energy could increase energy availability, but it also presents concerning downsides. Firstly, the transformation of crops into liquid fuels such as bioethanol and biodiesel are highly water demanding. As such, biofuel production results in competing uses of water and land. The major competition is obviously with food production, as energy crops may compete with food. The problematic link between energy and food emerges strongly in this sector. For instance, this link becomes a debated issues between SDGs advocating for renewable energy and climate change adaption (SDG7 and SDG13) and those aiming at no poverty and zero hunger (SDG1 and SDG2). Indeed, the former seem to support "green grabs"[6] which enhance competition over food, water, and land, in contrast with the first two SDGs (Dell'Angelo *et al.*, 2017). Indeed, biofuels can have negative effects on local food security, increasing both provision insecurity and food prices. This raise concerns over human rights violations involved in these large-scale land deals. What is more, the activity of intensive monocropping can be highly pollutant.

Hydropower appears even more complex. Dam projects entail the storage of large amounts of water. This can have positive effects, including increased energy provision and water availability for both irrigation and households. However, negative effects involve preventing water from reaching downstream sites and populations and the displacement of local communities. Indeed, hydropower projects involve in some cases human rights violations, with unequal redistribution of rights. What is more, beside affecting society, these projects are proven to be a burden also for the environment, affecting water quality and flows of sediments and nutrients downstream. The effects are perceived by the entire ecosystem, including biodiversity and fisheries which are crucial for many local inhabitant's food security.

The problems raised by the biofuels and hydropower sector would probably benefit from an increased integration and cooperation among the different sectors involved (FAO, 2021). The water-food-energy nexus could thus represent the optimal solution to reach an efficient and sustainable use of these resources in the renewable energy sector. What is more, renewables can have relevant

[6] Green grabs are intended as practices which aim at promoting climate change mitigation and reduced greenhouse gas emissions (i.e., through the promotion of renewable energy adoption) thereby supporting land acquisitions and enhancing competition over water, land, and food uses and users (Dell'Angelo *et al.*, 2017).

positive impacts in the water-food-energy nexus, as they can significantly reduce reliance on fossil fuels energy sources. However, these technologies involve both opportunities and challenges for the WEF sectors (IRENA, 2015). On one hand, they could enhance sustainability in water, food, and energy, an reduce conflicting uses, taking advantage of the trade-offs and relations between the three sectors. On the other hand, it is necessary to evaluate the impacts of each solution on water resources. Hydropower and bioenergy, for instance, present relevant water footprints which should not be overlooked in the processes of planning and decision making. An integrated approach could however mitigate the trade-offs between water uses. In the case of hydropower, for instance, integrated water management could allow for the maintenance of minimum environmental flows and storage for irrigation, reducing conflicts of uses (World Bank, 2016). It would however be better to address less water-demanding sources, such as solar and wind which, in a world where resources are increasingly scarce, represent a solution allowing for low emissions and reduced water withdrawals. Thus, even though the nexus can be an efficient approach to water, food, and energy management, it needs some careful thoughts.

What is more, as stated before, for the nexus to be effective, political matters such as poverty and inequality of access need to be addressed more thoroughly. In this sense, the concept of *energy justice* is emerging as an increasingly debated issue. It recognises the indirect impacts of projects related to water, energy, and food on human rights, promoting a human-centred approach to energy issues (Olawuyi, 2019; Jenkins *et al.*, 2015). It assesses where injustice emerges, which fractions of society are marginalised, and the possible solutions to reduce and delate such inequalities, including improvements in redistribution of benefits, in institutional representation, and in local knowledge mobilisation (Jenkins *et al.*, 2015).

Such an approach would allow to consider both social and economic benefits of clean energy systems. This appears particularly important in developing countries, where large shares of total population lack access to sufficient food, water, and energy resources. Decision makers have the challenging role of pondering their choices between food and energy, and efficient supply and equitable access (Rasul and Sharma, 2015).

4.4. The Lower Mekong Basin: a case study on hydropower dams

The Mekong River is one of the main arteries of the Asiatic continent. Stretching for 5000 Km, it is the seventh largest river in the world, and it also boasts a rich biodiversity. The river rises in the Tibetan plateau and flows towards south-east, crossing six different countries: China and Myanmar, constituting the *Upper Mekong River Basin (UMB),* and Thailand, Laos, Cambodia, and

Viet Nam, which are part of the *Lower Mekong River Basin (LMB)*. While flowing in Chinese territory, the river brings the name of Lancang. The Mekong River plays a crucial role for the people living in its proximity; indeed, it is reported to sustain the livelihoods of about 200 million people (Bompan and Iannelli, 2018). What is more, it maintains jungles, irrigate crops, and support the Tonle Sap Lake and its rich fish stock. The river's ecosystem relies on a delicate balance, which strongly depends on the monsoons that determine the river's rhythm. However, this balance is now under threat from what could be addressed as a dam rush. As of 2019, the LMB accounts for 89 hydropower projects and much more are expected to be built by 2040, when forecasts expect more than 30.000 MW to be generated (figure 4.3) (MRC, 2022).

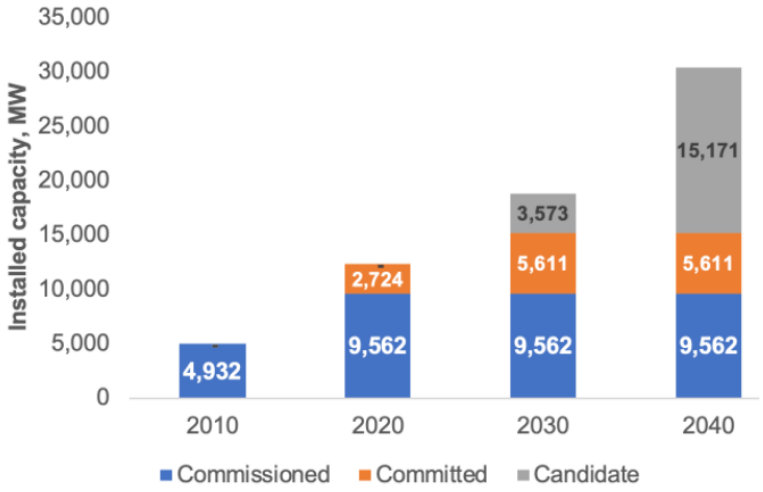


Figure 4.3: Commissioned, committed and potential hydropower projects. Source: Mekong River Commission (MRC) (2022).

The UMB reports large investments in hydropower, too. This mainly regard Chinese development plan. China built 11 dams on the Lancang and another 11 have been proposed (*ibid*). There is growing debate over the direct and indirect consequences of dam construction, and more information is needed to promote more effective and sustainable decision making.

4.4.1. The consequences of damming the river

Dams are for many a symbol of development and economic growth. As a matter of fact, it is estimated that if all proposed hydropower projects were to be made operative, the LMB could gain more than $169 billion by 2040 (*ibid*). For instance, the Laotian Xayaburi Dam sells 95% of the generated power to Thailand, providing the nation with a relevant source of income (Roney, 2021). What is more, the construction of a dam could positively impact other sectors, including irrigation,

which would benefit from water storage, electricity accessibility, increases national trade by improving navigation, and reduces risks from floods and droughts caused by climate variability.

The demand for energy is expected to grow by 6% to 7% per year. Hydropower represents an alternative source of energy to fossil fuels. In the LMB energy generation from dams increased by about 13 GWh, thus representing a valuable solution to increased energy demand in the region (*ibid*). Additionally, dams can play a pivotal role in flood and drought control and can be used for irrigation projects to better address the challenges presented by the dry and wet seasons. These trade-offs are important to achieve food security, energy security, and climate change adaptation.

However, these benefits come with some costs. Among the mainly addressed there are the worryingly low tide levels during the dry seasons, flooding and droughts decoupled from the monsoon variability, and reduced sediments downstream, which entail biodiversity degradation, including forests and mangroves, and stock fish reduction due to low nutrients in the water. That of reduced sediments is a particularly worrying issue, because, impacting floodplain soil fertility and fish caught, it can negatively affect the 60 million people depending on the river. What is more, sediments are an import support for riverbanks. Dams blocking the sediments flows are causing the collapse of riverbanks, sweeping away houses and land of riverine communities. Another great problem is that of biodiversity loss. Animals in the Mekong region rely on the rhythm of the river, determined by the monsoon (*ibid*). Dams inevitably alter the flooding and receding periods of the river, impacting fishes and nesting birds. Fish losses in the LMB could account for up to $23 billion cost by 2040, let alone the impact on rural, marginalised, and indigenous populations relying on the river (MRC, 2017). Another problem triggered by dams is the displacement of local communities. At the global level, the number of displaced people due to dam construction is estimated between 40 and 80 million (Richter *et al.*, 2010). In the Mekong region, the Three Gorges Dam in China displaced 1.2 million people; the Son La dam, in Vietnam, forced 16.206 people to leave their lands; the Lower Sean 2 in Cambodia displaced around 5.000 people; and this is the case for many of the other dams along the Mekong (Manorom, 2018). Beside the problems linked to the displacements, a further burden for these population are the missed promises of compensations, especially when the relocation is towards areas located far from the river.

4.4.2. Financing hydropower in the Lower Mekong Basin

Hydropower is proposed by those financing the projects as a way to take advantage of unexploited potential of the river body. They prise the several benefits of hydropower, including electricity provision, greenhouse gases reduction, attraction on foreign currency, and sustainable

development (Merme *et al.*, 2013). After the Asian financial crisis and the adoption of structural adjustment plans promoted by the International Monetary Fund, the Mekong region's countries improved their power sector and once regional commercial banks gathered enough capital, they increased financing towards hydropower. 36 hydropower dams were built in LMB between 1990 and 2012 and 5 large projects were realised in the UMB. In the LMB, hydropower business is booming as a consequence of regional developers' strong support to the construction of dams, increased private sector investments, support from International Financial Institutions, and policies which attract investments toward the sector (*ibid*). The most active investors in the region are Thai companies (EGCO, GMS Power, and Ratchaburi are some example), but also Vietnamese, Malaysian, and Chinese ones are gaining influence. What is more, global actors are involved, including French and Norwegian companies, global banks (such as ING, BNP Paribas, and Bank of Tokyo), and regional banks. Above all, regional commercial banks play a crucial role in the hydropower financing, and this allowed then to become influential actors also in decision making processes (*ibid*). the huge project of the Xayaburi Dam, for instance, was financed by four Thai commercial banks. The trend for hydropower investments in the Mekong region thus involves an increased role of regional commercial banks. Other trends identified is that of new actors, the private-public partnership, entering the power market and the increasingly private nature of ownership and finance in the sector. In some cases, the result of these trends is a transfer of authority (and, thus, decision making) from the public to the private sector (*ibid*). The governments are left to deal with the impact of dams, including displacements, ecosystem degradation, salinisation, fish stock reduction, and many other problems which cannot be adequately addressed if institution are not transparent and efficient. Unfortunately, this is rarely the case for developing and least developed economies.

4.4.3. The Water-Energy-Food Nexus approach in the Lower Mekong Region

Hydropower plants in the LMB may cover part of regional demand for energy. Regional demand is estimated around 820 TWh per year, and hydropower projects could cover demand for 65 TWh per year (FAO, 2014a). However, hydropower does not affect only the energy sector. Indeed, these large projects trigger a competition for water among different sectors, beside energy, including agriculture, fisheries, and food in general. As stated before, almost 60 million people rely on the river in the LMB. 80% of them directly depend on the river ecosystem for their daily subsistence. Overly damming the river would mean to affect the diets of all these people, which should shift to land-based proteins, as fish grows scarcer (*ibid*). Local communities would have to adapt by grazing for buffalo, cattle and goats and breed poultry. However, a shift towards livestock development is both land and

water demanding: to substitute water-based proteins could require from 13% to 27% more land and between 4% to 7% of additional water demand (*ibid*). This would in turn furtherly stress forests and water resources in the region. What is more, this process could lead to higher food prices. Given the poverty conditions which still characterise the area, even a small appreciation would threat food accessibility and availability for millions of people.

In addition, the river is shared by 6 nations, and the decision of one to build a dam will inevitably impact downstream countries. A regional integration appears fundamental in such a context. In the case of the Mekong River, a regional commission exists, the Mekong River Commission (MCR), which promotes cooperation and sustainability in the management of water resources in the LMB. However, self-interested actors (both private and public) may limit the nexus governance. In the case of the Xayaburi dam, for instance, Laos overruled the MRC and unilaterally started the project and disregarded the concerns of downstream Cambodia and Vietnam (Dombrownsky and Hensengerth, 2018)

In sum, efforts to achieve security in one sector of the nexus may entail increasing insecurity in the other two. Thus, an integrated approach appears not only desirable, but also necessaire. Policymakers need to take into account the trade-offs between energy, water, and food, in the attempt to include in their political decisions social, economic, and also environmental aspects.

Narratives of the water-energy-food nexus have been adopted in the Mekong Region both to support and contrast hydropower development. International organisations and foreign experts used the nexus narratives. For instance, the Mekong River Commission (MRC) refers to the nexus as a solution to promote transboundary cooperation over political and economic matters (Lebel and Lebel, 2018). However, these narratives had scarce effects on national policies and plans. Indeed, national development plans in the Mekong Region do not directly address or promote the nexus approach (*ibid*). The reasons could be different. For instance, the time needed for narratives to influence political decisions and political élites should be considered. What is more, nexus narratives seem mainly directed towards, where institutional capabilities to manage resource scarcity is limited. Finally, the WEF nexus narratives are not clear on practical operation to undertake for plans and policies to comply with an integrated approach (*ibid*).

CONCLUSIONS

The aim of this work was to assess the impacts of renewable energy-related investments on water resources accessibility in developing countries and proposing possible framework to better address the resource management. Renewables have overcome gas and oil as primary recipient of FDI in 2021. However, despite significantly lowering global greenhouse gas emissions, some of these technologies raise concerns over their sustainability. Impacts on society and the environment of these sectors are largely debated. The present thesis focuses on the water constraints from two renewables: biofuels and hydropower. The research brought about the necessity to better address the control and protection of this growingly scarce resource in the context of 'green' energy promotion. The role of institutions has been found as pivotal in favouring water grabbing practices, including in the renewables. As such, institutions and improved political tools are reported as an efficient way to deal with resources scarcity. The thesis thus proposes the assessment of a political tool, the water-energy-food nexus, to solve mismanagement issues in the water sector, and not only. Despite the existing flaws, this approach would allow to promote water, energy, and food security at the same time.

The focus on developing countries was chosen because they are the ones expected to suffer from water access constraint, while wealthier economies are believed not to experience water access issues. As a consequence, attention was directed to foreign direct investments (FDI). Indeed, trends confirm that financial inflows towards developing countries mainly come in this form. Analysing FDI inflows, the sector of renewables stands out. Following the health crisis triggered by convid-19 pandemic, two major forms of FDI, namely greenfield and project finance, declined significantly. Remarkably, renewables sector resisted this trend, with a slight decline. In 2021, it overtook oil and gas as the major recipient for foreign investments.

Given the recently acquired relevance of this sector in FDI trends, the work proceeds by analysing the impacts of investments in renewables in developing countries. The main subject of the thesis are water-related impacts. Chapter One thoroughly analyses the state of water resources in the world, and the frame pictured appears concerning. 771 million people still lack access to safe water. This is a problem of survival, economics, health, education, and for overall development. The emergency of a 'water crisis' is emerging strongly under the effects of the pandemics. The simplest way to reduce the risks from contracting the disease is basic handwashing; yet 3 billion people are still unable to access basic handwashing facilities. The pandemics, however, only represent an additional stressor to water scarcity. In the last decades, water resources have been increasingly put under stress. The primary drivers of water scarcity include population growth, urbanisation, changing consumption patterns, and climate change. It clearly emerges from the outlined context the urgency

to improve current strategies of water resource management. The central role of this resource in almost all economic activities is often overlooked, and so are the benefits of improving its control and provision, especially in developing and emerging economies. These are indeed the most affected by water scarcity, both physical and economic (meaning the one derived by bad water allocation). As trends of renewable energy investments towards these countries are believed to play an increasingly crucial role in national development, addressing the impacts on water resources and accessibility appears as relevant research.

Solar and wind are not deeply considered along the thesis, as they do not exert relevant pressure on water resources. Conversely, renewables such as hydropower and biofuels are intensive users of water resources and will thus be subject to in-depth analysis. From the conducted research, it emerged how biofuels and hydropower operations are often associated to controversial practices of *water grabbing*. The drivers and economic and political factors which ease the grab are thus addressed, in the attempt to shed light on how and why water grabs take place. The research reveals how constraints on access to water are driven by politics, rather than by physical scarcity. Government and market failures are reported as major facilitators of water grabbing practices. Therefore, institutional strengthening is unsurprisingly among the primary solutions to address water constraints, yet not the only one. Indeed, a 'water governance' approach is desirable, which proposes integration and cooperation between different scales: local, national, and international.

The research shed light on the complex relationship between water and energy resources, but it also revealed another important sector involved in this interaction. Indeed, a close relationship has been found between water, energy, and food. The three sectors appear entwined, so that any change in one's performance may affect the others. For instance, energy availability increase due to hydropower or biofuels operations may also entail water degradation and decreased food accessibility and affordability. In this context, the water-energy-food nexus approach is presented as a possible solution to the mismanagement of the three sectors. The nexus calls for an integrated approach to resource management to improve the nexus sectors' performance, both in efficiency and in sustainability. However, this approach is hindered by several factor and it presents some flaws which should be better addressed. Despite the negative sides, the WEF nexus appears as an efficient tool to improve water, energy, and food management, recognising and taking into consideration the undeniable liaisons which exist between the three sectors.

Hydropower development in the Mekong Region is then analysed. The environmental, social, and economic impacts of large dams in the Lower Mekong Basin make the region a perfect case study. The feasibility of nexus policies accounting for water, energy, and food trade-offs are

addressed, assessing if an integrated approach has been considered and applied. It emerged a fracture among regional and national institutions. The MRC adopted the nexus narrative to address water, energy, and food constraints, while nationally the nexus did not take root. Thus, power dynamics may be a great constraint to a nexus governance. The absence of a 'governance' approach can be seen as a cause of mismanagement of resources in the region, enhancing unsustainable behaviours. The case highlights how the lack of an integrated approach to WEF sectors management can lead to undesirable conditions, especially for the poorest fractions of population. As a matter of fact, sustainable resource management is closely linked to policies of poverty reduction, especially in rural areas and slums.

In conclusion, the work revealed that it is primarily local institutions playing a crucial role in the management of water resources, rather than FDI per se. In developing and least develop countries, where governments are more easily subject to regulatory capture and institutions are often weak and corrupted, water management may not be good enough to guarantee safe and equitable access to water resources. However, responsibilities seem to fall also on international and local actors.

Working through an integrated approach not only of sectors, but also of actors and scales appears crucial to address resources mismanagement. As a matter of fact, it emerged from the research that water grabbing practices are hindered where population is politically engaged and thus, more considered in decision-making. Therefore, community-based resource management could be more considered. The involvement of local communities has proven pivotal in promoting solutions which are both efficient and sustainable.

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