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Land resources opportunities for a growing prosperity in the Sahel

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The negative image of the Sahel is a stranglehold on the great potential for development in the region. A more balanced narrative can trigger action for a productive Sahel and can be based on innovative approaches and a conducive policy environment to value natural resources. Despite a rich set of information, the potential of the Sahel is still not flagged with sound knowledge that can be opposed to the conspicuous depressed perception. Positive transformation pathways require many improvements in the governance, finance and equity issues with a particular reference to the youth and women. The Sahel can sustain its sustainable development if transformation occurs in natural resources management. The paper analyses: i) the opportunities related to natural resources; ii) the potential and challenges for deep rapid transformation based on sound resources management practices; iv) areas for job creation and livelihood protection; and v) new models for financing these developments.

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Introduction

The Sahel has an image of a region with major environmental, economic and security challenges. The regional and international development agendas are mostly driven by these challenges and in places drive serious human insecurity with increased armed conflicts. The rapid demand for products and services, drought, famine, lingering poverty, food production deficit and marginalization of various vulnerable groups are among the factors of various crisis in the Sahel [1••,2••]. The Sahel has, for over 40 years, been seen as just a place of hunger, persistent droughts and climate extremes; a place where farmers struggle to produce the crops and livestock to sustain the growing population. Currently news coming from the region are dominated by security issues such as terrorism, and conflicts between communities. The living condition explain the unprecedented levels of migration [3] though up to 80% of the migration occur within Africa [4]

Unfortunately, this negative image overshadows the great potential for development that the region has preserved against all odds [2••]. This is because little has been known and said on the local opportunities in the Sahel to address these challenges. A new rhetoric leading to profound revision of existing development models is needed to reject the status quo that has sustained most policies without clear positive impacts since the drought of the 1970s [1••,5].

Surely it is important to look beyond humanitarian (e.g. immigration, food donations, medical aid) and military interventions (currently fight against terrorists' groups, ethnic clashes) to embrace locally efficient development actions to improve resilience based on natural resources [6]. This calls for an inclusive human security framework that consider the establishment of new functions for development based on communities' aspirations and equity. At the center of this aspiration, we suggest land restoration and natural resources to be the main drive [2••,7]. A starting point is a combined effort of public and private sectors, that leads to community benefits. The new economic model for the Sahel must be inclusive, sustainable and holds the potentials to transform people's wealth [8]. The foundation of a new rhetoric is to see the Sahel as having the human capital and the natural resources to generate quality products and create massive green jobs. Youth employment and the ability of producers, especially women to establish enterprises are aspects of the desirable outcomes for a region that seems to be losing hope because of the invariable message of depravation on its dwellers [9].

We therefore need to reassess some perceptions as well as the outdated heuristics dominated by rigid unidimensional understanding of the Sahel's challenges, for a new and stronger vision to harness the full potential in the Sahel. The proposed approach is to innovate and optimize the value of natural resources and ecosystems, as well as

ensure fair sharing of benefits with a particular focus on the poor, youth and women. This refers to as 'he Sahel's new deal' based on the implementation of land restoration/land resources sound ideas that involve high-level engagement, clear understanding of trade stakes for small enterprises, trade-offs or synergies in land use to harness benefits to local communities [10,11•].

This paper shows the opportunities to improve well-being based on new opportunities to realize a bigger range of benefits from natural resources; discuss new business models for successful innovation and job creation and mechanisms to financing the actions.

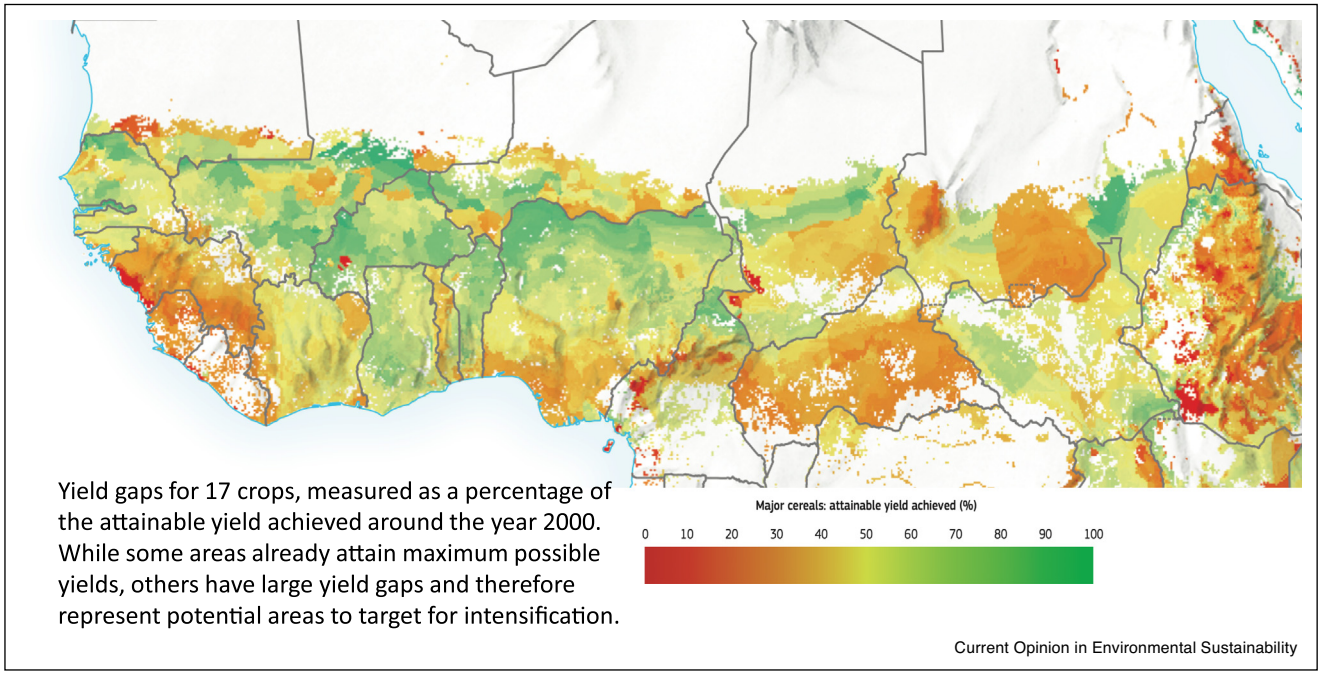
Agriculture and the Sahel's food production

In the Sahel, food shortages are recurrent, in 2008, 2010 and 2012, more than 15% of the population in the Sahel faced food insecurity due to a combination of drought, poor accessibility to food, high grain prices, environmental degradation, population displacement and conflict [12]. Yet promising opportunities exist to transform agriculture in the Sahel and stabilize the food production [13,14]. First the Sahel has large areas of fertile soils [15,16,17••] that have sustained secular livelihood in some highly densely populated regions such as the Senegal peanut basin, the Mopti region in Mali, the Maradi area in Niger, the Central region of Burkina Faso, Western Senegal, etc. In multiple places cereal yields are boosted using traditional low-cost approaches mostly based on agroforestry and soil fertility management [11•]. Practical solution such as better seeds, irrigation and fertilization could boost yields by 50% in the Sahel [3] Figure 1.

Yield gaps for 17 crops, measured as a percentage of the attainable yield achieved around the year 2000. While some areas already attain maximum possible yields, others have large yield gaps and therefore represent potential areas to target for intensification.

There is considerable potential for small holders' farmers to improve the efficiency and meet the growing food demand. In the future, demand of food must trigger a shift from unprocessed bulk products to value-added products, increasing the need for close public-private-people partnerships in agriculture, industry, manufacturing, trade, transport, finance, science, technology and the environmental management [18,19]. Many African institutions (African Development Bank, African Union's Comprehensive Africa Agriculture Development Programme) are encouraging important investment in agriculture as an engine for economic and social growth [20]. The successful agribusiness model for the Sahel should be centered around people as an intentional response to a growth strategy that fits the vast majority who depend on agriculture for their livelihoods. Rather than copycatting from highly technological agribusiness models based on monoculture and heavy use of chemicals, the model for

Figure 1



Closing yield gaps: Cereal attainable yield achieved, positive trend in the Sahel].
Source: The world Atlas on Desertification (2018) [17••].

the Sahel should rely on sustainable farming methods, climate-smart agriculture and sustainable land management [11•].

The investment on rice and maize, contrasts with the lose attention given to 'neglected crops' also known as 'orphan crop' or 'underutilized species'. As a result, many of the potential source of food in the Sahel have literally been forgotten [21,22]. These species include Sorghum, Millet, Fonio, Cassava and other protein-rich staples such as, Cowpea, Mung bean, etc. Research shows that improving the yields of neglected crops could be one of the surest and sustainable ways to address food and nutritional challenges and secure a robust food supply in the decades ahead [23]. Agricultural science could support that by matching-specific genetic traits to resist to the hardiness of drought and other stressors, nutrient deficiency, and, of course the ambition of high yield [24].

Land restoration is another opportunity to achieving a balance between the goal of food security through Sustainable Land Management (SLM) and ecosystem services such as water and nutrients recycling [25]. This relates to the combination of yield increase with environmental stewardship, merging two seemingly conflicting goals and ensuring that increased profitability contributes to local development and provides environmental benefits [26•].

Pastoral systems and source of animal food

The important question is how to address the challenges of pastoral resources use and the transformation of animal products? Serious concerns arise not only in regard to scarcity of pastoral resources (grazing and, water) and the increasing negative impacts of climate change. This adds to the urgent need to combine the urgency for increased productivity with more equitable forms of development that focus on poverty reduction of pastoral dwellers [1••,2••]. The pastoral system is a way of life, combining economic dimension but largely social and cultural aspects.

The Sahel's pastoral system lies at the crossroads of three major development opportunities: i) equity and growth ii) health and nutrition and iii) climate change solutions [27]. Livestock yield a significant source of fertilizers to fragile soils [2••]. On the economic side, in most Sahelian countries, 60–80% of rural households keep livestock as mobile and liquid asset, income generator, and food insurance [3]. Ruminant and monogastric livestock are key contributors to food security and job opportunities in the Sahel [28]. It is estimated that Africa needs to achieve around 6% annual growth in livestock productivity to meet the rising demand for animal products [27]. This includes sustainably intensified systems, such as improved rangeland management, new breeds and feed transformation and processing of meat and dairy [29,30]. The increased demand for meat in urban centers can be met if the pastoral system gains stronger support from public and private investment to improve feed and forage production to reduce overreliance on natural pastures that are prone to productivity variability under uncertain rainfall. Animal feed of good quality (and water) is perhaps the most critical limitation to increasing livestock productivity in the Sahel. The opportunity to improve the supply of animal products will highly depend on the ability to address endemic animal diseases [31,32].

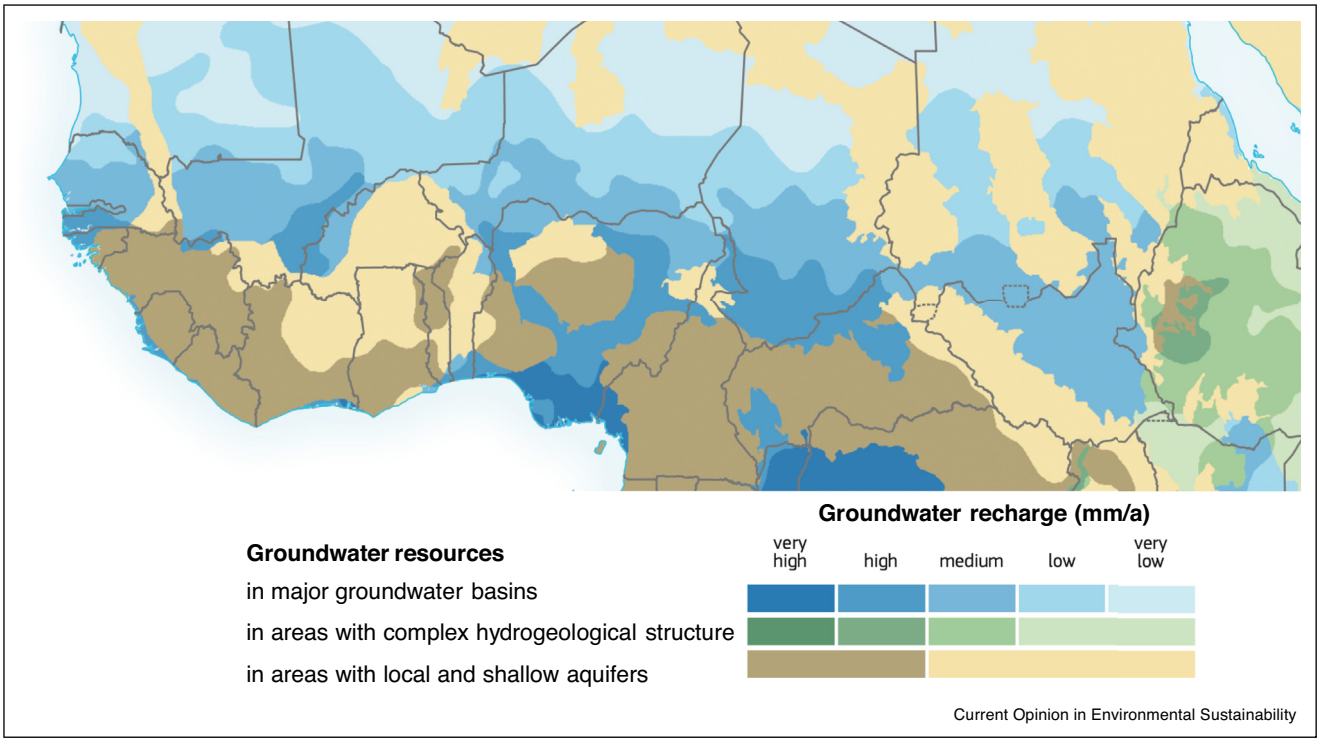
Tree and non-timber forest products

Achieving food and nutrition security under resource-poor conditions of the Sahel, requires a use of all potential food sources. The underutilized tree products have a huge untapped potential. Large proportion of the Sahelian population depends on tree products for food/feed, fire and fiber. In addition to ecological functions, trees have different roles for subsistence and commercial uses in semi-arid areas of Sub-Saharan Africa. Through agroforestry practices, many trees help improve nutrition, health and adaptation to climate change. Also, perennial crops, such as long-lived variants of beans and other sources of annual grains, and food-producing trees, which do not require soil ploughing and planting every year, will need to play larger roles for people's food supply and climate change mitigation [33].

Promotion of these trees will support agrobiodiversity and improve ecosystem health through soils carbon and micro climate improvement [34,35]. Ecosystem functions, including biodiversity and water services, are key to increasing resource efficiency and productivity and ensuring resilience. They are even more critical under the relevance of ecosystems services for adaptation. Ecosystem-based adaptation (EBA) has an important role in developing an agricultural sector that is linked to viable supply and demand value chains, well integrated into the broader landscape; is climate resilient and environmentally and socially sustainable [36].

Analyzing the facts and content of underutilized trees (outside of forest, or agroforest trees) shows an attractive image for their development in the Sahel. For instance, Moringa trees are very nutritious and grow (fast) in difficult conditions. The leaves are 30% protein on a dry weight basis, and full of minerals and vitamins [37]. Dried and powdered leaves are serving in various meals in dry regions of Africa [38]. Various other nutrition properties exist with a large list of tree species such as *Detarium* sp., *Grewia* sp., *Andansonia* sp., *Hyphaene* sp., *Nymphea*, *Saba* sp., *Parkia* sp., etc.). These add on the already promoted trees such as mangoes, cashew nuts, Arabic gum. These species are often combined with crops or pastoral systems and their consumption only limited to supplementary food, not really the main source of

Figure 2



Groundwater recharge (mm/a)].
Source. World Atlas of Desertification, 2018 [17••].

nutritious food. The opportunity is growing with increased demand of raising middle class in cities, but this require a larger share of the rural investment in the Sahel countries to produced exportable products as food booster to local and international food markets.

Never in the recent history of the Sahel the value of these trees had a strong standing in policy interest and focus for investment despite the beam of hope coming from the Great Green Wall Initiative (GGWI), a Pan-African initiative to establish multifunctional landscape approach as a way to reduce land degradation [39,40]. With and by trees on farm, the promotion of trees through adapted land management practices such as FMNR (farmers' management of natural regeneration), will accelerate productivity and support biodiversity. Recent research activities suggest that upping the yields of nutritious trees could be one of the surest and sustainable ways to avert the food challenges and secure a robust food supply in the decades ahead [33].

Water resources or the 'no-drought' opportunity

The level of extraction of renewable water resources in West Africa is less than one per cent [2••] of its potential. The water resources in the Sahel comes from the large transboundary regional watersheds, including Niger, Senegal, Gambia, Volta and Lake Chad; and large transboundary groundwater reservoirs such as, Lullemeden and Taoudeni (Figure 2). Groundwater resources exist both as the superficial water tables recharged during the rainy season and the fossil water reserves, including the deep-water tables of sedimentary basins. Considerable reserves of fresh water are stored in these deep-water tables, on a scale of thousands of billions of m^3 [17••]. In theory, they could fully meet the current and future needs of West Africa provided that the solar energy potential is also brought in the picture [1••]. These deep-water reserves have variable depths, sometimes reaching one to two thousand meters, and are non-renewable. The opportunities will be unlocked if we establish cohesive policies for the use of renewable energy to access ground water and part of that energy can be produced from rivers [41]. Moreover, sustainably managed dams to avoid downstream water shortages, nutrient clogging and sometimes conflicts around resource use and access to water bodies are often employed to store fresh water during dry season and build reserves during years of excess. They also help produce hydroelectric power), reducing dependence on fossil fuels. All these fresh water sources can support growing prosperity in many ways and more so in agriculture through sustainable irrigation [42]. The Sahel is not facing water scarcity or if it does in some condition it

is rather and economic water scarcity that be addressed through new funding mechanisms [43].

Another opportunity related to access to fresh water beyond direct food production and human consumption, is the aquaculture that currently receives a lot of interest in the Sahel thanks to the suitable natural environment that offers attractive conditions to farm and market a variety of local high-values species. In Senegal, Mali and Chad special programs for farming tilapia and catfish have already proved successful. As any activity that involves large investments in natural resources, aquaculture has potential for high returns but also involves certain risks – managing them successfully will require close cooperation between the public and private sectors [44].

Pathways for Sahel vibrant future

A better Sahel requires a special initiative that gathers the best practices in food production and natural resource valuation. Another Sahel is possible if we attract new funding, new partnership, novel governance systems that offer opportunities to stabilize and restore productivity of large areas that have fallen into disuse or function with low efficiency (Table 1). To harness the opportunities in the Sahel, it is important to revisit the barriers for inclusive development including the following:

1 Limitations in responding to increased market demand for agricultural products fueled by rapid urbanization and the population growth of the region's middle class.
2 Inadequate or non-existent local corporate services to support efficient supply chains for high value natural resources.
3 Challenges for the commitment of the private sector to source from African farmers.
4 Limited application of technologies that improve production and reduce food loss.
5 Context adapted policies that create an enabling environment for public and private enterprises that specialize in natural resources, including agricultural sector.

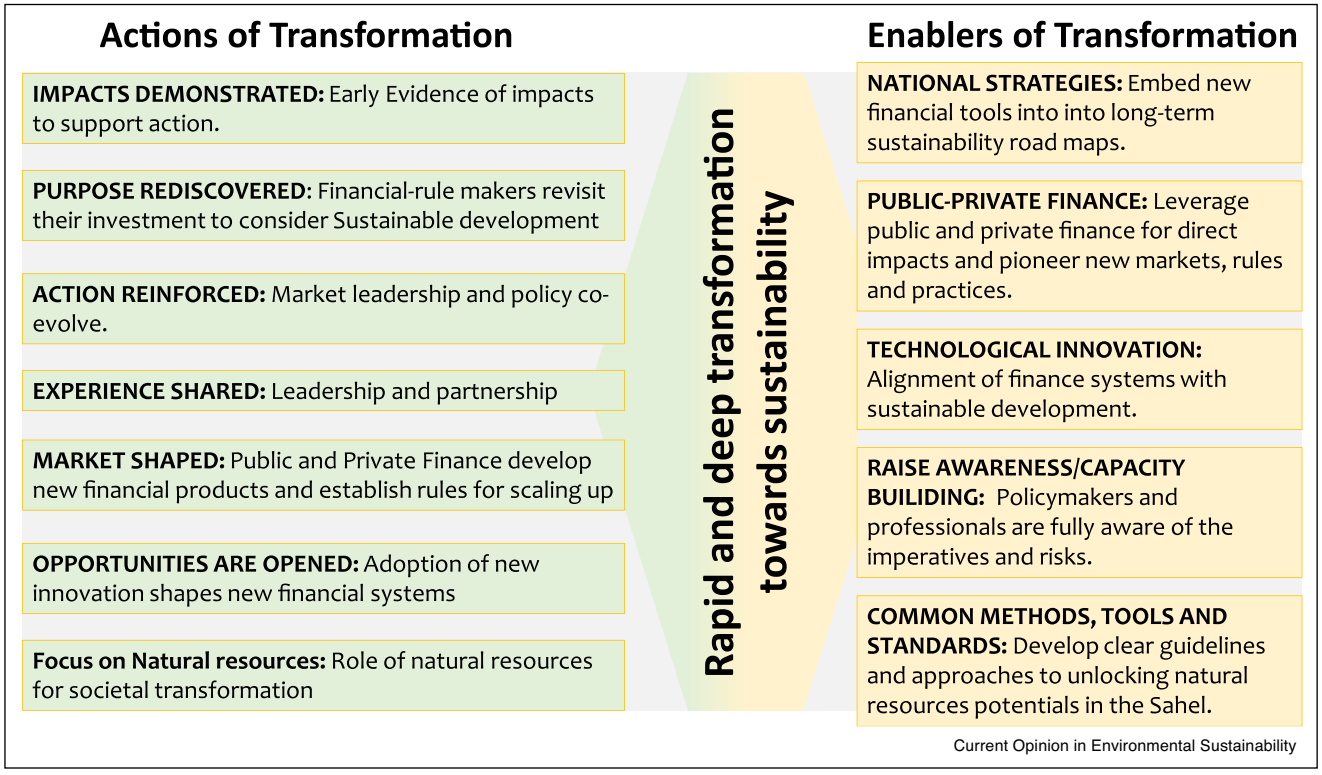
There is a need for novel financial mechanisms to establish the conditions for the greater flow of investment capital in the Sahel. The private investors will not alone

Table 1

Actions needed for transformation and its enabling conditions

Action areas	Opportunities	Barriers	Ref
Governance	Strong civil society Decentralization Synergetic cross-border cooperation on transboundary resources Effective planning using spatial and data management tools.	Limited participation of the youth and women Market Price of commodity Weak social protection	[45–47]
Financing mechanisms	Green funding is growing Export of commodities and cash crops Natural resources as a competitive development of the financial mechanisms High value natural products E-Finance, E-banking Insurance and micro-insurance Opportunities for combining local economies with national development goals	Unbalanced international trade Little funding in agriculture from public sources Low flow of investment capital in natural resources Gender Equity in accessing funding No culture for subscribing to climate change insurance.	[8]
Private sector and entrepreneurship	Innovations for natural products transformation Value addition Agro-processing activities Off-farm agribusiness and food retailing system	Little number of SMEs in Natural resources	[8]
Information and Communications Technology	Innovations in management of natural resources Use of mobile technology for data services Money transfer services	Little extension services Little market incentives and reducing trade barriers Weak regulatory environment Can increase in inequality and social differences	[48,49]
Managing land resources	Population mobility Land Degradation Neutrality, Great Green Wall, Agroforestry Natural resource-based growth also stimulates productivity in other sectors	Low quality of infrastructure to support land management Land competition Land grabbing Resources mismanagement	[2••,50–52]

Figure 3



Pathways for transforming the Sahel.

accept higher levels of risk for the sake of greater development benefit. A combination of national and multilateral mechanisms can mitigate the risks – for example, by accepting risk buffer provisions or providing investors with attractive terms of credit and favorable market advantages. The potential for blended financing is great, particularly in the development of new high value products. 'The Financial System We Need' [8] recommends testing new financial models in areas where traditional investment mechanisms were not able to fully unleash the potential for job creation, development of a green economy and achievement of sustainability goals. This is particularly valid for the Sahel where there is little presence of green finance recent efforts such as green bond markets, reallocation of capital, improvement of investment risks management and greater consideration pf environmental factors.

A Sahel's natural resources pathway includes strategies and actions that manage, use and maintain natural resources and the enabling factors that sustain their development. The pathways include technical improvement in resources management but also and most importantly the political and economic barriers that needs to be addressed. Figure 3 shows the transformations levies and the enabling factors related to them.

Conclusion

The Sahel is a poor region if we use the current economic standards, but that Sahel has so much natural resources and assets that can quickly support the deep transformation needed. The Sahel needs therefore a new narrative – one that is hopeful, dynamic and generates a sense of excitement at the potential of region to achieve large-scale improvement. An inclusive and responsible development can shift the focus to the real potential of the Sahel to develop and prosper and to stabilize and reverse current negative trends.

This paper reviewed selected opportunities in the Sahel together with the promising pathways to meet the development goals. Traditional approaches have proved insufficient to raise Sahelian countries out of the cycle of poverty, marginalization and dependence on foreign support. Going down the same path as the one followed during over 50 years now, is unlikely to improve the current status-quo. There is a strong potential for the Sahel to make significant improvement to livelihood security and develop new opportunities for its population. The new development approach must rest on a sound, responsible and equitable use of the region's rich natural resources. Where degraded, these resources need to be restored to productivity and higher levels of biodiversity.

The necessary steps to realizing this potential require a shift of the development strategies toward approaches that rely on the dynamism of communities and the entrepreneurial capacity of the Sahelian people. Unlocking this potential can have a transformative effect on the region, build insurance against the climate change and kick-start the development process to benefit the entire society.

The key to achieving these goals lies in attracting investments, and the present obstacles to the flow of capital must be urgently addressed. This means not only deploying the full range of risk mitigation measures in the private, public and blended finance sectors, but also making use of the innovation that has characterized sustainable finance over the past decade.

Conflict of interest statement

The authors used a grant from Rockefeller Foundation to host the initial meeting at Bellagio Center. The workshop was a set of scientists who have no conflict of interest f = with the donors. The paper capture some of the discussions from the meeting and use recent literature to sustain the arguments.

We declare that we do not have any conflict of interest with the donor.

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