Energy-Food Challenges and Future Trends in Mozambique and in the Maputo Province

Lorenzo Rinaldi and Davide Danilo Chiarelli

Abstract Mozambique is one of the richest countries in sub-Saharan Africa in terms of natural resources and agro-ecological assets. However, the country does not look on track for the achievement of the SDG 2 (Zero Hunger) and 7 (affordable and clean energy) by 2030. The population with access to electricity is around 30%, while 1.9 million people are estimated to be in high levels of acute food insecurity, with a strong imbalance between urban and urban areas. The Maputo Province, being the economic centre of the country, faces an above-average condition in respect to other areas of Mozambique. The policy frameworks as regards both energy and food production are indeed mainly focused on the development of the Great Maputo area. At the same time, major weaknesses hindering a more sustainable and even access to basic resources in this area are related to a) the ongoing use of coal and biomass for cooking purposes and the difficulties in adopting more clean and renewable energy sources; b) the impact of climate change, water scarcity and land / water competition on small-scale subsistence farming, as well as land-grabbing issues related to the presence of transnational food companies. In this context, the main challenge for policymakers is to translate the richness and availability in resources into effective policies, to support local economic activities and enable sustainable development also in terms of clean energy, and healthy and nutritious food access. Based on insights from "Boa_Ma_Nhã, Maputo!" project, this chapter focuses on these two interrelated dimensions of the WEF nexus (Energy and Food), focusing on specificities of the Great Maputo area. The essay further discusses future patterns provided by authoritative institutions to provide insights on potential criticalities and challenges to be overcome and orient more integrated and sustainable energy and food security-related policies.

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L. Montedoro et al. (eds.), *Territorial Development and Water-Energy-Food Nexus in the Global South*, Research for Development,
https://doi.org/10.1007/978-3-030-96538-9_8

1 Overview of the Energy Situation in Mozambique and the Maputo Province

1.1 Electricity Production and Access

Mozambique is a country full of natural resources, representing a valuable opportunity if effectively exploited to produce energy. The Mozambican electricity production mix is poorly diversified: the main source for electricity production is water, which is exploited for 83% of the domestic production (IEA 2019), thus creating competition with food production. In 2015, it was estimated that 73% of water withdrawals were for agricultural purposes and 65% for irrigation. However, crop production remains mainly rainfed in the country (FAO 2016). Mozambique is crossed by 104 river basins including the Zambesi River, the fourth longest river in Africa, and the Limpopo, the second main river of the Southern Africa region. The main hydroelectric plant in operation is represented by the 2075 megawatt (MW) of Cahora Bassa, located in the Tete Province, at the border with Zambia, Zimbabwe and Malawi. Due to this strategic geographical location, Cahora Bassa represents a cardinal electricity production node, and therefore a large portion of its production is exported among other Southern Africa Power Pool (SAPP) member countries. In matter of electricity supply from hydroelectric plants, very few is the installed capacity in the Great Maputo area, which hosts only the plant of the Corumana dam (16 MW) located in the Moamba District. In terms of future development, more than 1400 hydroelectric projects are currently in the feasibility assessment or under development. One of the projects with a major priority is the Mphanda Nkuwa plant with a planned capacity of 1500 MW. As a whole, the Mozambican hydropower potential is estimated to be 19 GW (Gesto-Energia 2000).

In the second position within the electricity production mix, there is natural gas, accounting for almost the totality of the remaining domestic electricity, despite the huge potential for exploitation of other sources. Natural gas represents one of the Mozambican main assets from a strategic point of view, placing the country in a relevant position on the international market, especially towards Asia. Two are the main natural gas reserves off the coast of the country. The Pande and Temane gas reserves, located in southern Mozambique, are estimated to contain 3.5 trillion cubic feet of natural gas. Developed by the South African Sasol, 90% of their production is exported to South Africa via pipelines while the remaining is left for domestic use, exploited in the cities of Maputo and Matola (MIREME 2018).

The second reserve is the Rovuma Basin gas fields, off the coasts of the Cabo Delgado Province, in the North of the country. The recent discoveries of the Rovuma Basin represent some of the largest gas fields in the world with a capacity of 128 trillion cubic feet (EDM 2018). This massive potential is envisioned on one side to increase the power generation capacity through the implementation of combined cycle power plants, and on the other to boost export revenues from the sector.

The national power system is managed and operated by Electricidade de Moçambique (EDM). According to the company statistics (EDM 2015), the national electricity grid nearly doubled in length from 2009 to 2015, increasing from 9252 km to 16,662 km. The southern provinces, in particular, the Great Maputo area, benefit of a much better electric service with respect to the rest of the country, and this is both a cause and a consequence of the higher level of development. The grid extension trend was uniform within the country, yet Mozambique is still at the bottom line in terms of electricity infrastructure. Such weak infrastructures lead to one of the lowest rates of access to electricity in the world. More than 70% of the population lacks access to electricity; moreover, this value increases dramatically considering rural areas only, reaching almost 95% (World Bank 2021). Access to electricity is also strongly dependent on the region in Mozambique, with an alarming imbalance from North and Centre Provinces (around 17%) to South (56%). The Maputo area is the most developed region in the country in terms of electricity access: 91% of the population of the capital was connected to the national grid in 2015, while, in the surrounding districts, this value approaches to 79%.

1.2 Biomass: The Backbone of the Energy Mix

According to the 2007 census data, only 29% of the households in the Maputo Province reported electricity as their main source of energy supply. However, more than 35% of the population of the area was connected to the national grid. With relation to the total population of that year, it means that 15 thousand households in the area preferred other energy sources to electricity. Considering this data refers to the most developed region of the country, it is reasonable to derive a far worse condition in the other regions.

Figure 1 highlights a strong dependence on biomass: aside from representing the second resource in terms of domestic energy production (left-side chart), it is also not exported at all. On the right-side chart, it is clear how biomass is the backbone of Mozambican energy consumption, especially from households and public and commercial services. Everywhere in Africa, biomass is the heart of the energy mix, and due to economic but also cultural reasons, it will be difficult to replace. Despite significant growth in GDP per capita from 611 to 1258 USD between 2000 and 2018, according to the IEA, in 2012, about 25 million people in Mozambique were relying on the use of traditional solid biomass for cooking purposes, especially in rural areas (IEA 2014). Moreover, in the same period, only an additional 2% of the population gained access to clean cooking solutions (IEA 2019).

A focus on the districts of Boane, Moamba and Namaacha is also provided in Table 1. According to data coming from the INE (National Statistics Office), despite oil products were reported to be the primary energy supply source at domestic level, with more than 60% of share in all Boane, Moamba and Namaacha Districts, electricity is already the second most utilized source with around 20% share (INE 2013a, b, c). Despite such conditions can be attributed, in absolute terms, to a underdeveloped

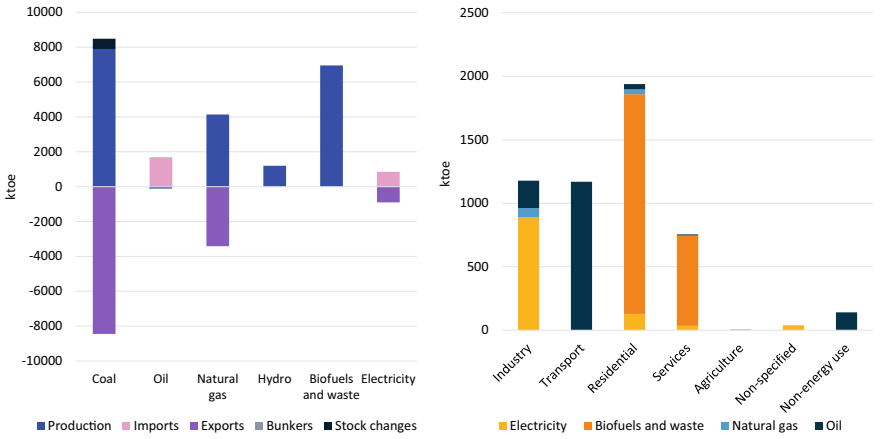

Fig. 1 Energy supply (left) and final consumption (right) in Mozambique, 2018. *Source* Elaboration of the authors based on IEA data (IEA 2021)

region, it is to be noted that in the rest of the country the numbers may be much more shifted towards less clean fuel utilization.

Still referring to the Great Maputo area, aside of the residential demand, the only industrial utility to be served is the Mozal smelter, which accounts for a large portion not only of the local, but also of the national demand of electricity. Electricity to serve the Mozal is coming from exports, since there is no infrastructure that links it with the main power plants located in the northern provinces.

1.3 Unexploited Opportunities for Improvement

Despite the unfortunate current energy situation, there are considerable margins for improvement. Starting with the hydroelectric potential, the country is crossed by 104 river basins of which 13 are main basins counting the Zambesi River, the fourth longest river in Africa, and the Limpopo, the second main river of the South African region. More than 1400 projects are identified to increase the generation capacity: the one with the highest priority is the Mphanda Nkuwa plant with a planned installed capacity of 1500 megawatt (MW). In the Maputo area, another hydroelectric plant of 15 MW capacity is under construction in the Moamba District. According to the Mozambique Renewable Energy Atlas, the Mozambican hydropower potential is estimated to be 19,000 MW (Gesto-Energia 2000). A feasibility study is underway for the construction of a biomass power plant in Moamba, with a capacity of 30 MW. Other relevant sources of unexploited potential are solar and wind energies, which are estimated as 23 terawatt (TW) and 4.5 gigawatt (GW), respectively. A 30 MW wind power plant is expected to be in operation by 2027 in Namaacha. Considering the currently installed capacity of 1 GW for photovoltaic, this provides insights on the big

Table 1 Households preferred energy sources in Moamba, Boane and Namaacha. *Source* Elaboration by the authors based on data from INE (2013a, b, c)

	Boane		Moamba		Namaacha		Maputo Province		Maputo City	
	n. HH	%	n. HH	%	n. HH	%	n. HH	%	n. HH	%
Electricity	6086	24.0%	2674	18.3%	2302	21.7%	79,054	29.3%	137,756	63.0%
Generator/solar panel	94	0.4%	49	0.3%	51	0.5%	1012	0.4%	391	0.2%
Gas	13	0.1%	5	0.0%	2	0.0%	131	0.0%	81	0.0%
Oil products	16,245	64.0%	9777	66.9%	6408	60.5%	161,738	59.9%	64,192	29.4%
Candles	2564	10.1%	1405	9.6%	1382	13.1%	21,998	8.1%	15,164	6.9%
Batteries	41	0.2%	21	0.1%	15	0.1%	703	0.3%	533	0.2%
Wood	265	1.0%	600	4.1%	353	3.3%	4368	1.6%	135	0.1%
Others	85	0.3%	79	0.5%	75	0.7%	920	0.3%	272	0.1%
Total households	**25,393**		**14,610**		**10,588**		**269,924**		**218,524**	

steps that may be performed in this direction. Three 30 MW photovoltaic plants are expected to be deployed in Boane, respectively, in 2024, 2030 and 2038. However, mainly due to the elevated cost of renewable technologies, their deployment is not highlighted as a priority in the government masterplans, which are mainly focused on the development of the gas extraction and export sectors. The foreseen investments in the energy sector are concentrated, in fact, towards the development of the fossil fuels (specifically gas) industry, which may represent a rapid way to place Mozambique in a better position on the energy market.

Another aspect that deserves a specific discussion is the off-grid potential. As mentioned previously, the national grid is sparse, and its improvement is highly capital-intensive. Exploiting the off-grid potential is of paramount relevance for policymakers. However, providing access to electricity is not just a matter of connecting the user to a smart meter, but ensuring a durable, reliable and affordable service (Bhatia and Angelou 2015). Usually, the most adopted energy solutions to provide access to electricity without relying on the national grid are solar home systems and microgrids. While the former is usually capable of serving a few basic appliances, the latter can provide proper access to electricity in remote regions, especially in the case of hybrid plants, in which renewable potential is complemented with storage technologies as well as diesel generators as back-up. While microgrids are widely diffused in Southeast Asia, they are not so common in Africa, and Mozambique is not an exception (ESMAP 2019). While the number of publicly financed projects is increasing, mainly managed by the Energy Fund of Mozambique (FUNAE), a sub-division of the MIREME dedicated to rural electrification projects, privately funded projects usually crash against a wall of difficult administrative barriers, which disincentivizes private stakeholders.

2 National Energy Policies in Mozambique

The government strategies in the matter of energy sector development are clear. Both the "Natural Gas Master Plan" and the "Integrated Master Plan of Mozambique Power System Development" state that the main ambition of the country is to increase the revenue coming from natural gas resources exploitation (MIREME 2018; INP 2014), having the long-term objective of improving social and economic conditions of the population.

Focusing on the power system, the government strategies comprise a development plan of the generation, transmission and distribution infrastructure for the time horizon 2018–2043. At the current state, the Mozambican national grid is divided into two independent systems: the southern and the central and northern systems. For this last reason, the generation development plan was developed in two stages: the first stage considers the two systems as separated and is implemented for the period 2018–2028, while the second stage considers the two systems as interconnected between 2029 and 2043, forecasting such link to occur in 2029.

The generation development plan targets all the on-grid power systems across the and is based on a least-cost method modelling approach. Indeed, since the country, as mentioned, has a huge potential in primary energy, the strategy proposed by the master plan is going to be implemented by using different kinds of power plants such as hydroelectric power plants, coal- and gas-fired power plants, solar and wind power units: adopting different technologies, different levels of investments may be needed. Given the current economic situation of the country, adopting a least-cost approach seems the most reasonable methodology to track the future deployment of capacity and fulfil the estimated demand for electricity, trying not to impact food production.

To estimate the future electricity demand, the final users were divided into three different categories: (a) *general customers* constituted by households and other small customers supplied by low voltage; (b) *medium-large customers* supplied by low and medium voltage and (c) *high-voltage customers* served by high volt. Another category is that of the s*pecial customers*, which is composed of all the customers whose contract considers a supply of 1 MW or more. The demand forecast was performed at three levels: at the customer side, at transmission substation and a power station, considering transmission and distribution losses and was estimated based on the macroscopic indicators (i.e. GDP, population growth, etc.), complemented by specific analyses dedicated to the special customers since they impact significantly the overall demand. The correlation among electricity demand, population growth, GDP, electrification rate and electricity tariff has been analysed using historical data. The results showed that there was a strong correlation between the first three indicators and the demand, defining them suitable. On the other hand, regarding the electricity tariff, instead, since the correlation was weak, it was not significant for the forecasting.

The optimization algorithm takes as input the estimated demand and provides the best technological solutions to meet such demand level while minimizing the total investment and operation costs to be put in place. The installed units are selected among a set of already planned projects, and technical parameters are characterized for each generator unit.

2.1 Possible Criticalities in Future Trends

The policy documents foreseen a large deployment of capacity, estimated in almost 10 GW in total up to the year 2043, to be compared with the current installed capacity for power generation which is lower than 3 GW. The main deployed technologies are expected to be hydroelectric power plants, with almost 4.4 GW of new capacity, gas-fired power plants (2.6 GW) and coal power plants (1.9 GW). Renewable energy technologies shall keep covering a marginal portion of the total electricity demand, with an expected capacity of 680 MW in total. The strategy proposed by the Mozambican government does not differ significantly from the ones reported by other institutions. The IEA, for instance, in its “Africa Energy Outlook report”, displays an

electricity production mix up to 2040 which is strongly unbalanced towards hydro and gas plants, with a negligible share of renewable production (IEA 2019).

The planned technological solutions provided in the policy documents present, however, some critical issues attributable to the underlying modelling approach adopted. Firstly, the selected installed units come from a pre-defined list of already planned projects. This is in line with current policy statements, which aims at maximizing the exploitation of recently discovered natural gas reserves: gas is expected to increase its share in the electricity mix as well as its weight in foreign trades since in 2040 more than 50 of the 80 billion cubic feet (bcf) produced will be exported. However, the followed approach limits the degree of freedom of the model, which could provide alternative solutions, which may be more convenient.

Secondly, macroscopic trends such as population growth or cross-sectoral linkages are not accounted for within the boundaries of the model, and therefore the costs related to the resulting solution may neglect additional costs to be sustained in other economic sectors. The economic efforts, in any case, will be probably dramatically high: at least 110 billion USD may be necessary for the installation of the new plants and to improve the grid infrastructure. This translates into 5.5 billion USD to be invested each year, around 32% of the national GDP in 2014, the year of publication of the master plans. Considering the situation from a post-pandemic perspective, the challenge seems even more difficult, since the national economy experienced a downturn during the COVID-19 emergency.

In the end, it seems MIREME master plans do not focus on the growing trend of increasing access to clean cooking. In the most conservative scenarios, the share of the population gaining access to clean cooking solutions is expected to quadruple. Thanks to the widely available gas resources, the main resource in this matter is represented by the diffusion of Liquid Propane Gas (LPG) cooking stoves. However, nowadays, while 90% of energy needs for cooking are supplied by biomass and coal, the most adopted clean cooking technology is electric stoves over LPG ones (7% against 3% in the total energy for cooking supply mix). If this share will be respected in the future, it may represent a further issue that apparently has been neglected within the demand forecast process: electric cooking may significantly increase the consumption level of electricity, revealing the technological solution provided by the master plans as sub-optimal or even unsuitable.

3 The Agricultural System in Mozambique and in the Maputo Province

Mozambique is considered as having a great potential for agricultural production as well as energy production; however, it is not yet exploited nowadays. Malnourishment and food security are still on the agenda in the country.

Agriculture contributes 26% to the GDP and is the backbone of the country's development with about 70% of the population heavily dependent on agriculture as

their primary source of livelihood (FAO 2016; Ferrão et al. 2018). The smallholder "family" sub-sector accounts for about 98% of the area under production: production is largely rainfed and with low yields. Food crops include mainly maize, cassava, rice and beans for household consumption. Private companies represent the remaining 2% of the cropland area, often irrigated, producing mainly cash crops such as cotton, cashew, sugarcane, tobacco and soybean (FAO 2016; Cammaer 2016; Silici et al. 2015).

Mozambique has considerable agricultural potential thanks to its rich endowment of natural resources. In this context, only 90,000 ha are irrigated, even though irrigation potential was estimated to be around 3.1 million ha (de Sousa et al. 2017).

In the Great Maputo area, for example, approximatively 70% of the maize water requirement, the most widespread crop in the country, is satisfied by precipitation during the wet season. In the district of Moamba water gap is higher only 67% of crop water demand is satisfied by rainfall, while in Namaacha we reached 72.3%. Thus, we can expect that the total crop yield could not be reached unless water with irrigation is provided in the field. Water withdrawal for agricultural purposes in the artificial reservoir of the Pequenos Libombos dam, along the Umbeluzi River, clearly highlighting how the water withdrawal for agriculture mainly occur during the dry season.

Annual water scarcity map (Fig. 2) shows how water is generally available in the district of Namaacha, while water scarcity is experienced in the district of Boane and Moamba, thus showing how proper irrigation schemes could be realized without compromising local availability of water.

3.1 Possible Future Trends and Guidelines

Crop diversification and organic production have been highlighted by local expertise[1] as a way to enhance small-scale agriculture in the region. These suggestions are identified in order to provide more resilient strategies for production that is less connected with the local market of a single product and could be at the same time competitive with the neighbouring production coming from eSwatini and South Africa. Thanks to irrigation and cheaper production cost, products from South Africa are sold at a lower price than the same products harvested in Mozambique, where moreover small farmers are only able to get one unique harvest during the wet season.

Improving irrigation system is a necessary strategy to increase crop production of local farmers ensuring a double cropping during the year. Irrigation systems are usually possible when farmers organize themselves in associations or cooperatives in order to ensure their maintenance, while the initial financial input is anyhow

[1] Empirical evidence has been provided—in the context of "Boa_Ma_Nhã, Maputo!" project—thanks to the discussion with local farmers and researchers, as well as direct observation of farming activities in Boane and Namaacha. Interviews included members of the 25 de Septembro cooperative in Boane and colleagues from the Sabie Agricultural Research Centre, Department of Agronomy and Forestry Engineering of the Mondlane University.

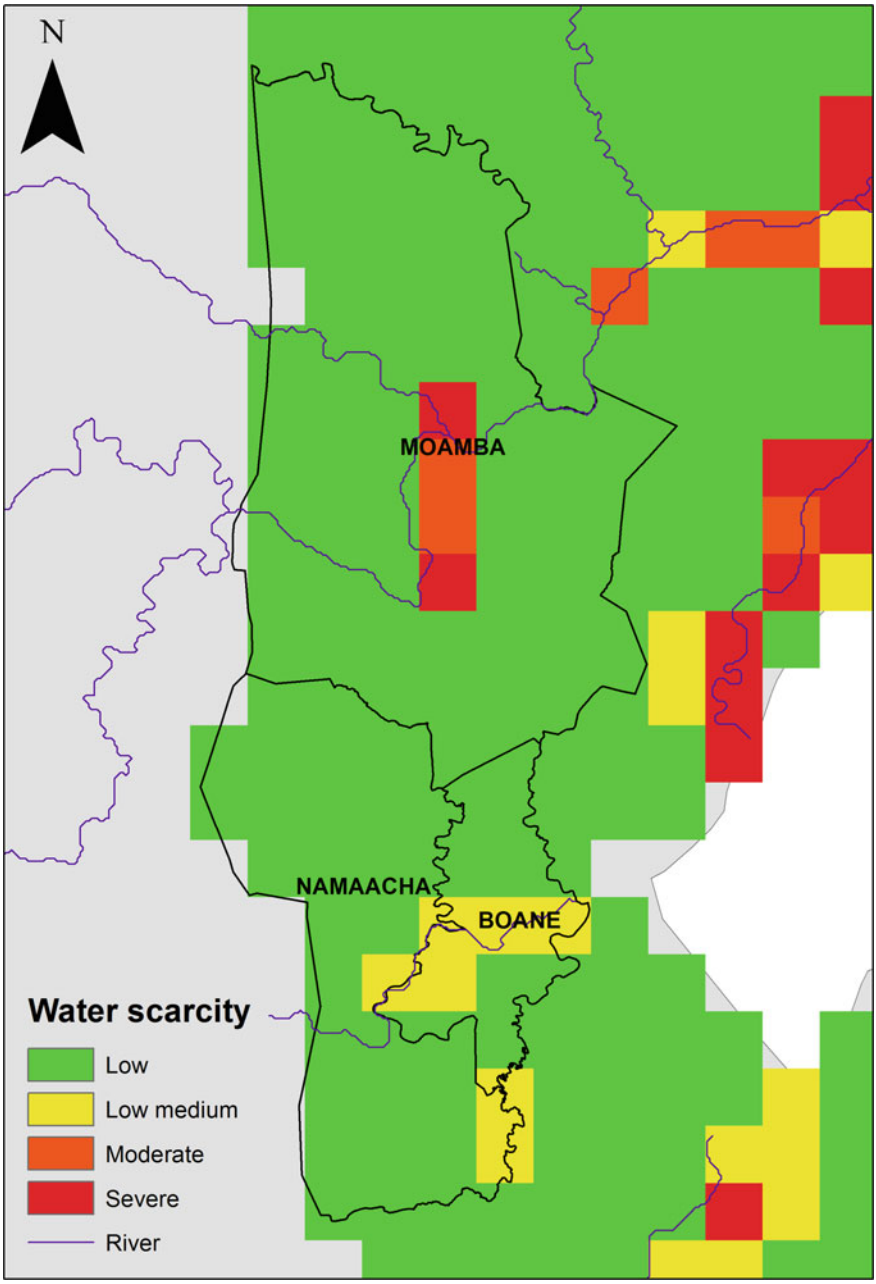

Fig. 2 Water scarcity map in the Maputo province. *Source* Elaboration by "Boa_Ma_Nhã, Maputo!" team (D. D. Chiarelli), 2019

provided by external private companies or international cooperation agencies. An example is represented by the 25 de Setembro cooperative in Boane that is currently including more about 35 farmers mainly harvesting horticultural, vegetables and maize. Improving the knowledge of local farmers is another important key point to be stressed. Agrarian schools and universities are present in the Maputo Province, but usually diplomats and graduate students prefer administrative careers in local institutions over entrepreneurial careers as farmers, thus without a return of acquired knowledge on the ground.

3.2 Foreign Investment in the Agricultural Sector and Consequences

To have a complete overview of agricultural production is Mozambique, however, we cannot neglect to include foreign investment in the agricultural sector. Currently, in Mozambique there is no private ownership of the land, everything is state-owned. With the 1997 Land Law, the State declared itself owner of the land but committed itself to guarantee the right to use it. This right is perpetual for those who make it a domestic and subsistence use, while companies in search of land to be dedicated to agribusiness are required to renew this right, at low cost, every 50 years, provided that the use complies with approved development plans and environmental constraints.

Because of the nationalization of land, a weak and unstable political situation, and especially because of the liberal and market-oriented development model promoted by the central government, Mozambique is heavily subjected to land acquisition mechanisms for private investments in agribusiness, forestry and mining. These mechanisms are creating serious impacts both on the environment and smallholder farmers (Rulli et al. 2018; Chiarelli et al. 2021).

Moreover, the rare irrigation schemes are often associated with cash crops like bananas and sugarcane mainly harvested by foreign investors, while smallholder farms usually survive thanks to rainfed agriculture. Examples of these foreign investments are Bananalandia, located in the Boane District, and Agrisol, in the Moamba District. In these districts, water gap is high, only 67–73% of crop water demand is satisfied by rainfall. Thus, only providing water with irrigation can help reach total crop yield. These harvested areas also receive high inputs in terms of fertilizers and pesticides.

4 Conclusions

Mozambique is undergoing an unfortunate situation, characterized by general underdevelopment, poverty, malnutrition and difficulties in access to food which is reflected also in the energy sector. Even if the Maputo metropolitan area is by far the most

developed region of the country, the current infrastructure is not sufficient to satisfy basic needs and planned energy and food security solutions for the next two decades present important criticalities which should be investigated and tackled carefully. Despite the current conditions are not promising in the perspective of achieving SDG 2 and 7 targets by 2030, there are significant margins for improvement, from the unexploited renewable potential to the diffusion of off-grid microgrids for energy supply, while the revenues coming from the natural gas market may enable positive dynamics of economic growth. The agricultural sector needs also new strategies to increase crop production for both local and international markets. Improving irrigation schemes could be the best way associated with an increase in energy supply if local farmers may also have access to them.

References

Bhatia M, Angelou N (2015) Beyond connections energy access redefined. ESMAP Technical Report. Available via World Bank. https://openknowledge.worldbank.org/handle/10986/24368. Accessed 22 September 2021

Cammaer R (2016) Tracing sustainable agriculture in Mozambique: from policy to practice. International Institute for Environment and Development Working Paper Series. IIED, London

Chiarelli DD, D'Odorico P, Davis KF, Rosso R, Rulli MC (2021) Large-scale land acquisition as a potential driver of slope instability. In: L. Degrad. Dev. 32(4):1773–1785 https://doi.org/10.1002/ldr.3826

de Sousa W et al (2017) Irrigation and crop diversification in the 25 de Setembro irrigation scheme. Mozambique. Int. J. Water Resour. Dev. 33(5):705–724. https://doi.org/10.1080/07900627.2016.1262246

EDM—Electricidade de Mocambique (2018) EDM strategy 2018–2028. EDM, Maputo

EDM—Electricidade do Moçambique (2015) Relatorio anual estadistica. EDM, Maputo

ESMAP—Energy Sector Management Assistance Program (2019) Mini grids for half a billion people: market outlook and handbook for decision makers. ESMAP Technical Repor. Available via World Bank: https://openknowledge.worldbank.org/handle/10986/31926. Accessed 22 September 2021

FAO—Food and Agriculture Organization (2016) AQUASTAT country profile—Mozambique. FAO, Rome

Ferrão J, Bell V, Cardoso LA, Fernandes T (2018) Agriculture and food security in Mozambique. J Food Nutr Agric 1(1):7–11. https://doi.org/10.21839/jfna.v1i1.121

Gesto-Energia SA (2000) Renewable energy atlas of Mozambique. Gesto-Energia, Alges

IEA—International Energy Agency (2021) IEA data and statistics. Available via IEA. https://www.iea.org/data-and-statistics. Accessed 22 September 2021

IEA—International Energy Agency (2019) Africa Energy Outlook. Available via IEA. https://iea.blob.core.windows.net/assets/2f7b6170-d616-4dd7-a7ca-a65a3a332fc1/Africa_Energy_Outlook_2019.pdf. Accessed 22 September 2021

IEA—International Energy Agency (2014) Africa Energy Outlook. A focus on the energy prospects in sub-Saharan Africa. Available via IEA. https://www.icafrica.org/fileadmin/documents/Knowledge/Energy/AfricaEnergyOutlook-IEA.pdf Accessed 22 September 2021

INE—Instituto Nacional de Estadísticas (2013a) Estadísticas do Distrito de Boane. INE, Maputo

INE—Instituto Nacional de Estadísticas (2013b) Estadísticas do Distrito de Moamba. INE, Maputo

INE—Instituto Nacional de Estadísticas (2013c) Estadísticas do Distrito de Namaacha. INE, Maputo

MIREME—Ministério dos Recursos Minerais e Energia (2018) Integrated Master Plan—Mozambique Power System Development. MIREME, Maputo

Republica de Mozambique. Instituto Nacional de Petróleo (2014) Natural Gas Masterplan. Available via INP: http://www.inp.gov.mz/en/Policies-Legal-Framework/Policies/NATURAL-GAS-MASTER-PLAN2. Accessed 22 September 2021

Rulli MC, Passera C, Chiarelli DD, D'Odorico P (2018) Socio-environmental effects of large-scale land acquisition in Mozambique. In: Bellaviti P, Petrillo A (eds) Sustainable urban development and globalization. New strategies for new challenges—with a focus on the global south. Springer, Cham, p 377–389

Silici L, Bias C, Cavane E (2015) Sustainable agriculture for small-scale farmers in Mozambique. Country report. International Institute for Environment and Development, London

WB—World Bank (2021) Wolrd Bank open data. Available via Word Bank. https://data.worldbank.org/. Accessed 22 September 2021