PROMOTE SUSTAINABLE INDUSTRIALISATION AND FOSTER INNOVATION THROUGH A PPP IN AFRICA

Abdelkader Djeflat*

Chairman
Maghtech Network
University of Lille, France
Abdelkader.djeflat@]univ-lille1.fr

ABSTRACT

Purpose: Our contribution addresses Objective 9 of the SDG agenda, and more specifically the second part of it which is *to promote sustainable industrial development and foster Innovation through PPP*. The purpose is to answer three important questions:

1. How can we involve the private sector in a new PPP strategy to address SDGs that will fulfil Goal 9, to promote industrial development and innovation in the North Africa region and the continent as a whole?
2) What new visions and new policies are needed, and what support from all key players including Government, the business sector and civil society?
3) What necessary instruments need to be mobilised, and what advocacy is required to get large buy-in on the part of the private sector and society as a whole.

Design Methodology/Appproach: Our data and illustrations are essentially from the African region. Time constraints did not make it possible to conduct a specific and tailor-made field work for the problems we have

*Corresponding Author

chosen to examine. Thus, the data is drawn from earlier work done on sustainability and knowledge based economy where broad samples of policy-makers, entrepreneurs and people in the academic sphere were interviewed (DESA, 2016).

Findings: Successful PPP for the SDGs rests on the collaboration of three spheres: *The Government sphere, the research sphere*: and *the industry sphere*, similar to the "triple helix" type of framework. However, when it comes to the African context, this simple formula will not work unless other spheres are involved. These include: the *social acceptance sphere*, the *donors' sphere* and the *international organisations' sphere*. This requires a great of social innovation to accompany and ease this process. In this respect SDG 9 needs to be combined with Objective 17 if PPP is to succeed.

Originality/value: The originality of our work is to look at SDGs PPP through the lens of industrial development: it is our belief that the partnership will not be successfully achieved if proper capabilities are not built in the field of science, technology and industry.

Keywords: SDG Objective 9; industrial development; science technology and innovation; social innovation; PPP

INTRODUCTION

Sustainable Development Goals (SDGs) can be considered as one of the most important development agenda to guide the action of the international community for the next 15 years. Their importance stems from their broad and all-encompassing objectives and their true global nature: unlike the Millennium Development Goals (MDGs), whose targets were the poor, SDGs include all the community at large, both in the global south and the global north. They are also very timely at a time when humanity is becoming more and more conscious of the dangers it faces if the appropriate actions are not taken to face the risks our planet runs in terms of climate change, environmental pollution, bio-diversity destruction, and so on.

While being the emanation of a large consensus among the Nation States and considered as one of the biggest achievement in the history of the UN (General Secretary of the UN), the implementation of the SDGs could not possibly rest only on the shoulders of the State and on public funding. As stated in Objective 17:

> "*A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, are needed at the global, regional, national and local level*".

SDGs will not be successfully achieved if proper capabilities are not built in the field of science, technology and industry.

Raising the issue of sustainability in LDCs also necessarily raises the issue of science and technology (S&T) capacity building. We have highlighted in earlier work the importance of technology transfer between developed and developing countries in the protection of the environment (Djeflat, 1996). We argued that technology transfer is a win-win game, whereby developed countries find both material and moral gains, while, through better access to environmental technology, LDCs can contribute to the enhancement of sustainability, both at home and the world as a whole. Therefore, special treatment should be given to environmental technologies. This is, of course, far from being the situation in the field: market forces and short-term gains are still key factors.

Our contribution addresses Objective 9 of the SDG agenda and more specifically the second part of it, which is, "*to promote sustainable industrial development and foster Innovation through PPP*".

Key questions can be raised: how could sustainable industrial development be reached while an important proportion of countries in the world, namely in the Global South are totally excluded from the manufacturing sphere and have set no basis for proper industry? How could this objective be reached while mineral resources represent more than 70% of GDP and are the only commodity being exported? How could they be achieved while the numerous and repetitive S&T policies have produced no notable progress in building proper capacity in R&D and innovative activities, and the S&T content of their exports is very dismal? How could the private sector be involved after being marginalised for so long in the various S&T policies and its share of the R&D budget is insignificant? Finally, what PPP model could we discover to make Objective 9 feasible within the span of the 13 remaining years of SDG implementation?

These are some of the questions we will attempt to answer in this paper. To do that we will draw from both the existing literature and from the work we have done in areas related to the key issues raised here. Our data and illustrations are essentially from the African region. Time constraints did not make it possible to conduct a specific and tailor-made field work for the problematics we have chosen to examine. The next section looks at industrial development and the current issues it faces in African countries to show how it is highly unsustainable. The next section will examine how innovation is a difficult task in these countries, and how this contributes towards making economic and more specifically industrial development unsustainable. This is followed by an examination of the issue of PPP in African countries, its shortcomings and difficulties it meets when it comes to promote industrial development and innovation. Finally, we put forward certain proposals to make PPP a feasible model to promote sustainable industrial development and innovation.

INDUSTRIAL DEVELOPMENT AND SUSTAINABILITY ISSUES IN AFRICAN COUNTRIES

The Importance of Industrial Development

Industrial development is more and more recognised as a key element that enables the developing world to face the challenges posed by demography, youth unemployment, sustainability and growth, and inclusive development. "*Enhancing an economy's productive capabilities over an increasing range of manufactured goods is an integral part of economic development*" (Rodrik, 2006). Manufacturing is an important employer, accounting for around 470 million jobs worldwide in 2009, or around 16% of the world's workforce of 2.9 billion. In 2013, it was estimated that there were more than half a billion jobs in manufacturing[1]. Industrialisation's job multiplication effect has a positive impact on society: every one job in manufacturing creates 2.2 jobs in other sectors. It is also fundamental for providing technological solutions to environmental problems.

The Difficulties met by Industrial Development in Africa

Weak and falling MVA and dis-industrialisation

However, industrial development is not easy when it comes to developing countries with limited financial, material, human resources and, more specifically, knowledge capital. We have to consider different categories of countries, not simply at a GDP level on an economic model. The first category includes those that have confined their activities to the development of agriculture and the rural sector, and the exploitation of important mineral resources when they are available. The manufacturing sector is poorly developed, and industry-driven development in this case can be a daunting task. The second category contains countries where important steps were made to develop and enhance an industrial sector essentially driven by revenues from natural resources, e.g. oil, gas and other minerals in Algeria. The third category includes countries without significant mineral resources but a thriving private sector in the manufacturing sector (e.g. Tunisia). However, when looking at these countries closely, irrespective of the category to which they belong, manufacturing value added has not reached a satisfactory level to the extent that it can be a powerful engine of growth. This applies to the whole African continent, with the exception of South Africa, as indicated by weak and declining manufactured value added (MVA).

[1]http://www.un.org/sustainabledevelopment/wp-content/uploads/2016/08/9_Why-it-Matters_Goal-9_Industry_1p.pdf

The share of MVA of African countries in total MVA of the developing world kept dwindling from 4.3% in 1995 to 3.1% in 2011, at constant price 2000 (see Figure 1). The share of MVA of total value added has been stagnant for a decade and a half, not exceeding 7%, the weakest compared to Latin-America (about 15%) and Asia (25%). One of the problems we have witnessed in recent years is the important drawback in industrial strategies, particularly in Africa and Latin America, while the private sector was either absent or had a very small share of the domestic industrial effort. The dis-industrialisation phenomenon took place, resulting in the closure of tens of manufacturing outlets and laying off of thousands of workers, some with a significant knowledge capital and valuable experience. This decline massively concerned the public sector, but was not compensated by the private sector.

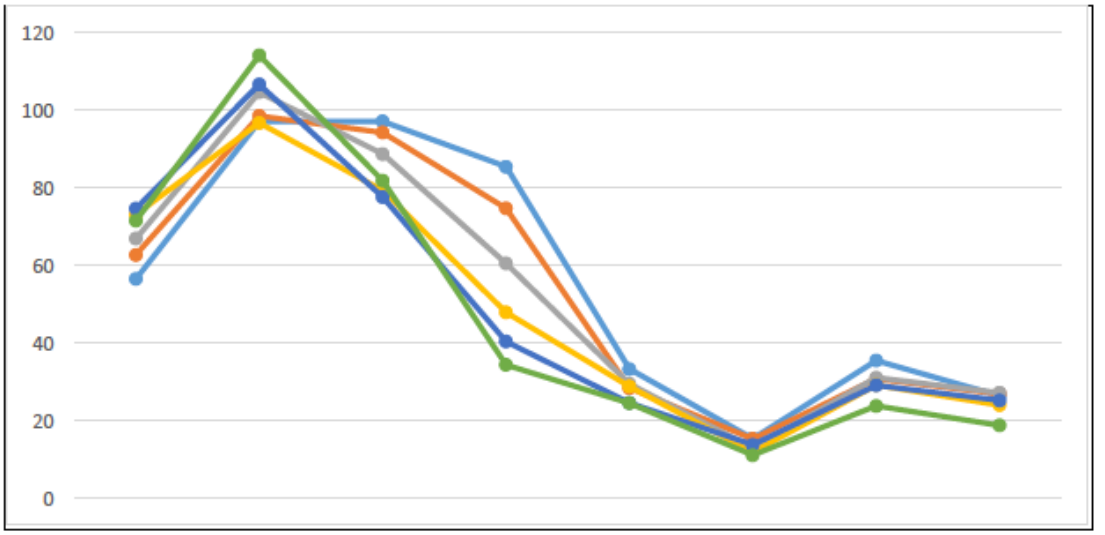

Figure 1 Evolution of the Production of Indust Products in the Public Sector: 1999—2004

Source: The author

Examining the trajectories of public sector companies indicates a cycle with three stages:

Phase 1: growth of production: until 1999: high investment, increased growth of production. Increased acquisition of equipment, training contracts, technical assistance, subcontracted design and engineering: unrecognised: learning by doing, transfer of technology, development of design and engineering capabilities.

Phase 2: decline: 1999—2011: privatisation of major industrial complex, dismantling of industrial production units. In Algeria, 1,015 large public enterprises and 3,000 local enterprises (EPLs) were closed, resulting in the suppression of 400,000 jobs. This led to an increase in unemployment, which reached more than 2 million people

(Djeflat, 2008), laying off workers (with significant loss of accumulated know-how and skills), e.g. in the metallurgical industry, the production of industrial tanks, 900 workers were laid off, dis-industrialisation, de-engineering.

Phase 3: stagnation and decline: 2011 to the present day: stagnation of production: 1980−1984: de-engineering, de-design, lack of currency, pressure from Breton wood institutions, halt (closing down): 2000−2014: privatisation.

Weak and stagnant innovation effort

It is commonly known that successive S&T policies in the developing world, and Africa in particular, have delivered very few capabilities in terms of innovation, as shown by various studies.

Efforts devoted to promote R&D and innovation are rather weak in most African countries: gross expenditure on R&D had not reached 0.5% of GDP in 2008, with the exception of South Africa, Uganda and Malawi (Table 1). Although they succeeded at the sectoral level, they were not inclusive and did not enhance the already important inequalities. They were mostly driven by the State and publicly owned companies, leaving very little space for the private sector.

Table 1 Gross Expenditure on R&D in a Sample of Sub-Saharan Countries (2008)

	Year	GERD million PPP$	GERD per capita PPP$	GERD as % of GDP
Gabon	2008	78.7	58.3	0.47
Ghana	2007	120.1	5.0	0.38
Kenya	2007	277.8	7.4	0.48
Malawi	2007	180.1	12.9	1.70
Mali†	2007	37.4	3.0	0.28
Mozambique*‡	2007	42.9	2.0	0.25
Nigeria*†	2007	583.2	3.9	0.20
Senegal	2008	99.0	8.0	0.48
South Africa	2007	4 976.6	102.4	1.05
Tanzania*	2007	234.6	5.8	0.48
Uganda†	2007	359.8	11.6	1.10
Zambia	2008	55.3	4.6	0.37

Sources: ASTII R&D Surveys; PPP data from UNDP (2010); population and GDP data from AfDB (2010)

Note:

* Data do not include the business enterprise sector

† Data do not include private non-profit institutions/organisations

‡ Data do not include the higher education sector

Implications of the Regression Process

This situation has several implications on the sustainability of growth, particularly when it is coupled with the significant decline of the price of mineral resources witnessed in the last four to five years.

The most significant impact often unrecognised and badly documented is the downgrading of the capabilities that are so vital for industrial growth and which are scarce resources in African countries. Table 2 highlights some of these capabilities and pinpoints to some of the likely causes for their downgrading.

Table 2 The Downgrading of Major Capabilities

Loss of assets	*Effects*	*Causes*
Production regression	Des industrialisation	— restructuring — privatisation — competitive pressure
Human capital loss	De learning	— flight of competencies — laying off of workers — unrecognised tacit knowledge — Dutch disease
Knowledge capital loss	Regression of R&D	— unfair competition (free trade zone) — informal sector — financing
Institutional regression	Downgrading of institutions and actors	— institutional instability — rivalry & petit politics — vested interests — corruption

Source: The author

Most countries will continue to rely heavily on mineral sources and, with the fall of market prices, will intensify the exploitation of these resources to compensate for lost income. They will also continue to rely on fossil products as sources of energy. This can be illustrated by the current debate on whether to exploit shale gas to make up for lost income, because of the decline of oil and gas prices in Algeria for example.

The countries will have less budget to devote to sustainability objectives in their various forms. Lack of capabilities will enhance their dependency on importing ready-made equipment and activities where sustainability is not the prime concern in their design. Manufacturing activities are sometimes outsourced to escape stringent rules at home.

The lack of massive job creation will drive a high proportion of the active population to join the informal sector. This sector is known to have activities and behaviour that can be harmful to the environment; they are largely uncontrolled and the enforcement of rules and regulations is extremely difficult.

INNOVATION AND SUSTAINABLE INDUSTRIAL DEVELOPMENT

The Importance of Innovation in Sustainable Growth at the Firm Level

As stated in Objective 9 of the SDG agenda, investments in infrastructure, transport, irrigation, energy, and information and communication technology are crucial in achieving sustainable development and empowering communities in many countries. More directly relevant to our paper, the second part of Objective 9 is *the promotion of sustainable industrial development and fostering innovation through PPP*. It is now a fact that technological progress is the foundation of these efforts to achieve environmental objectives: "*Without technology and innovation, industrialisation will not happen, and without industrialisation, development will not happen*".

If we take the mining sector as an example, studies have shown that environmental performance correlates closely with production efficiency, and environmental degradation is greatest in operations that work with obsolete technology, limited capital, and poor human resource management. Firms that pollute the most are mismanaging the environment precisely because of their inability to innovate. The most efficient firms are generally better environmentally managed, because they are innovators and are able to harness both technological and organisational change to reduce the production and environmental costs of their operations (Warhurst, 2000).

Examples throughout the literature show that innovation can reduce pollution, and that firms that adopt this strategy build competitive advantages as well as environmental benefits. In terms of theory, Tilton (1992) shows that innovation is a key element in sustainability using cost and benefit analysis, the two key elements in the decision-making process for environment protection. The approach in terms of internal and external costs deserves some attention (Figure 2). The argument rests on the assumption that the socially optimal use of an environmental resource occurs when the additional benefits (in terms of the goods and services it derives by permitting one more unit of pollution) equal the additional costs it incurs, the point at which MSB = MSC.

While this approach gives precious insight into the trade-off between social costs and social benefits, and broadens the classical cost/benefit analysis to encompass environmental consideration, it fails to integrate the technology factor. One of its basic assumptions is that technology is externalised in the analysis and that firms operate with a given level of technology. The hypothesis of static technology does not hold anymore, particularly in an era where technical change is occurring at a relatively high pace. In effect, technology is one of the key elements in the equation. The marginal social costs (MSC) are in a lower position while the marginal social benefits (MSB) stands at a higher position: environmental innovation therefore becomes a necessity.

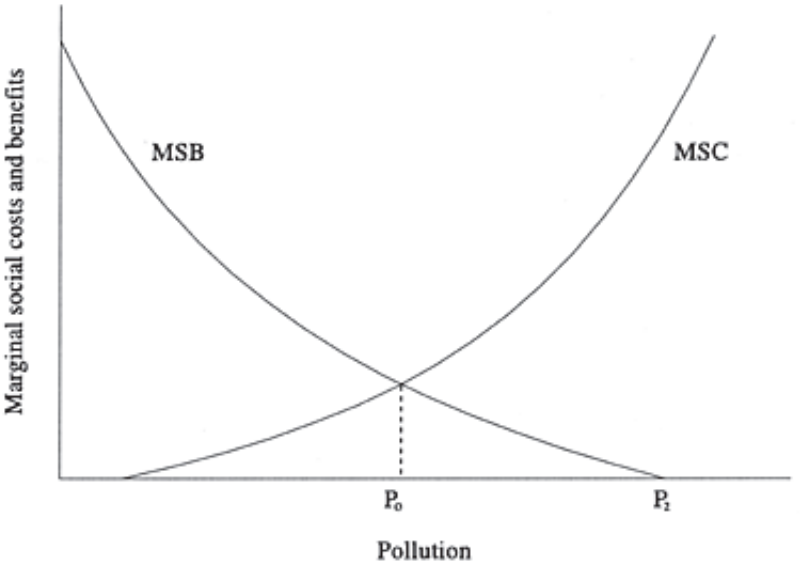

Figure 2 Trade-off between Marginal Social Costs and Marginal Social Benefits and Equilibrium

Source: Warhurst (2000)

The Importance of State Action: The Regulations

While conventional wisdom is that regulatory regimes of the polluter-payer type are the driving force behind better environmental management and that they are sufficient to put pressure to reduce social costs, the reality is that they suffer from major flaws. The first is the everlasting problem of enforcement, which is known to be weak in many African countries and which results from problems in governance. Second, they tend to presume that technology is static, based on a technology "that was best at one time". In effect, such regulations could act as a disincentive for technology suppliers to innovate, knowing that innovations require substantial R&D resources. Regulations requiring the polluter to pay tend to lead to end-of-pipe, add-on, or capital-intensive solutions for existing technology and work practices, rather than promoting alternative environmental management systems and technological innovation (Warhurst, 2000). In the face of stringent regulations, less innovative firms are driven to either close down or to export pollution to developing countries that have less-restrictive regulatory regimes. With the increasing awareness on the part of LDCs regarding social costs, the second alternative is less and less practical. Research conducted in the mining sector nonetheless suggests that the environmental performance of a mining enterprise is more closely related to its innovative capacity than to the regulatory regime under which it operates (Warhurst, 2000).

This suggests that technical change that is stimulated by environmental considerations, instead of increasing costs, tends to reduce both production and environmental costs, to the advantage of those dynamic companies with the competence and resources to innovate. These companies are adapting to environmental regulatory pressures by innovating, improving, and commercialising their environmental technology and environmental management practices, at home and abroad.

Examples from the mining industry show that firms are investing in R&D in order to develop more environmentally sound technologies. Also, they are beginning to sell their technologies, preferring to commercialise their innovations to cover their R&D costs than to sell obsolete technology and risk shareholders' displeasure or retrospective penalties. Other examples show that new opportunities could be opened by regulations for both equipment suppliers and polluters themselves to innovate. New and more stringent noise pollution regulations in the field of noise pollution in the 1970s saw the emergence of a host a new products and services for noise control in Great Britain and some Scandinavian countries, including from the polluters themselves (Djeflat, 1975).

On more global terms, technical innovation, for instance in terms of developing substitutes to naturally scarce raw products, may help to overcome the fact that *natural capital* cannot always be reproduced. In terms of policy implications, environmental legislation needs to be completed by mechanisms to promote environmental innovation, and mechanisms to stimulate the diffusion of these innovations among firms.

However, pollution control and environmental protection are only two of the objectives of sustainable development. Sustainability is also about reducing poverty, education, health and welfare, the agricultural sector, and rural development. Nonetheless, while the issues of environmental protection and innovation are gathering more and more support and comprehension, systems of innovation (Lundvall, 1992) and sustainability still raise some key questions.

PPP AND SUSTAINABLE INDUSTRIAL DEVELOPMENT AND INNOVATION IN AFRICAN COUNTRIES

The Limits of State-led Industrial and Innovation Policies

The main feature of industrial development in most African countries has been the dominant posture of the State in promoting industrial development and innovation through successive attempts to implement S&T policies. Recent measures have tried to bring in the private sector in manufacturing through a host of incentives. However, limited attempts have been made to design a proper PPP in this endeavour.

It is now clear that industrial policies driven essentially by the State have met their limits and cannot promote sustainable growth, notwithstanding all the efforts made over the last 40 years by certain African countries (Nigeria, Kenya, Algeria, Egypt, and others).

Similarly, in several countries in the South, and in Africa in particular, State led innovation policies have failed to deliver the necessary goods and services, not only to constantly and rapidly changing domestic demand but also the requirements of globally competitive markets.

The Limits of Business led Industrial Development for Sustainability

While the impact on local industry can be quite substantial in terms of employment creation, outsourcing to local industry with the effect of upgrading their facilities and know-how, and perhaps in some cases, triggering a real innovation dynamics, examples and success stories to substantiate that, are still relatively limited. This is particularly true when it comes to African countries, with the exception of South Africa.

Competitive pressures tend to increase outsourcing of innovative activities and progressively reduce the national base for innovation systems. More and more firms are driven to outsource their activities to the so-called low wage countries. Firms seek mostly to harness local research capabilities while paying relatively lower wages compared to wages back home. This behaviour is also seen in the field of environmental protection and sustainable development. R&D is driven by market needs and profit considerations. In this respect, the national base of innovation systems is gradually eroded, consequently reducing the basis of sustainability. Local competencies and research capacities are diverted from national projects and programmes for sustainability to pressing market needs.

THE NEED FOR A PPP FOR INNOVATION AND SUSTAINABLE INDUSTRIAL GROWTH

Innovation, Sustainability: A Collective Effort

Innovation and sustainability have common features: while being led by the State through public policies, they are both systemic and are, in essence, more of an evolutionary obedience. The State cannot be efficient on its own through regulations and public policy. Similarly, in a neo-classical framework, the private sector and market pressures on their own cannot help achieve the discounted results. It is a collective effort, involving interaction between several actors that matters (Rothwell, 1992).

This is in line with Objective 17 of the SDGs, which stipulates that:

> *"A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, are needed at the global, regional, national and local level".*

Several spheres are involved for a successful mix of innovation sustainability and industrial development.

The Government Sphere: The Government sphere is needed because of the strong regulatory dimension through a variety of mechanisms; this is well documented in the SDG agenda. They include policy orientations and decisions, and a variety of mechanisms for the implementation both of a fiscal and non-fiscal nature.

The Research Sphere: The Research sphere plays a distinct role as sustainability rests on the limitation of a variety of hazards to the environment and to mankind; they require new knowledge and multi-disciplinarity. Both constantly extended and basic research are vitally important.

The Industry Sphere: The Industry sphere is essentially the private sphere because of the need to transform ideas and inventions into much needed and marketable goods and services. The private sector alone, on the other hand, has not been able to invest in any significant way in R&D. This effort is estimated at less than 6% of total R&D effort in Maghreb[2] countries on average, and often resulted from a mismatch between science policy and innovation policy.

These three spheres constitute the *public private partnership node of sustainability*. (Djeflat, 2005). However, it is not enough when it comes to innovation and sustainability concerns. Other spheres also have an important role to play (Figure 3).

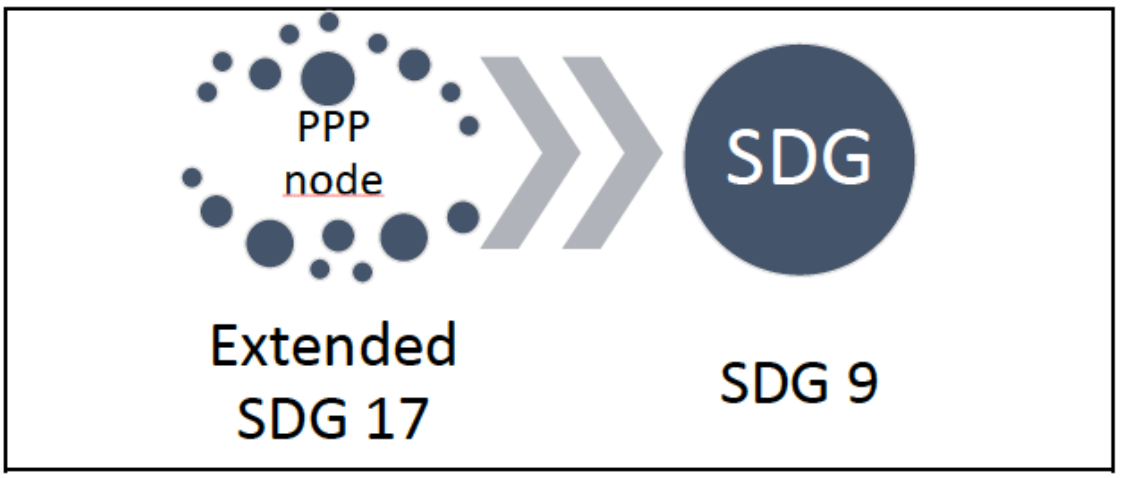

Figure 3 The SDG Objective 9 Extended PPP Framework

Source: The author

The Social Acceptance Sphere is essential because of the need for diffusion and increasing social acceptance of the new technologies, sometimes changing well en-

[2]The Maghreb is a major region of northern Africa that consists primarily of the countries Algeria, Morocco, Tunisia, Libya and Mauritania.

trenched mentalities and hard to die habits. In African countries, where inclusive innovation and sustainability include the fight against poverty, inequality and exclusion, social acceptance is vital for new products and services with high sustainability contents. In this respect, innovation in industry and manufacturing need social innovation to accompany and ease this process.

The Donors' Sphere: The donors' sphere is much needed because of the hazards that these countries suffer, and the high risks they run in terms of unequal distribution of wealth, diversion of resources to private ends and rent-seeking. New products and services with sustainable contents could be used for the richest section of the population.

The International Organisation Sphere is needed to set and monitor rules and regulations and their diffusion throughout the world, such as the SDGs: it contributes to raising awareness and setting up incentives for compliance R&D and sustainable innovation.

The Financial Sphere: finally, we have the banks and financial institutions sphere: namely those concerned with implementing UNCED objectives and with policies to promote the international diffusion of clean technology.

These are shown in Figure 4 and Table 3 below.

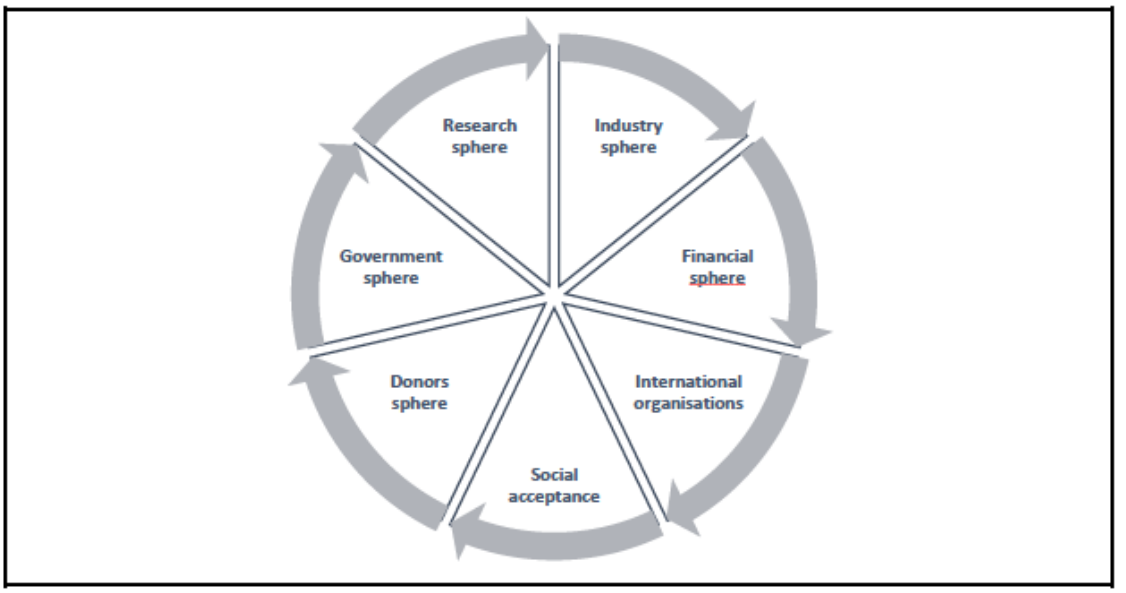

Figure 4 The Various Spheres Involved in Environmental Protection and Sustainable Development Innovation Systems

Source: The author

Table 3 The Various Spheres and Actors Involved in Environmental Protection and Sustainable Development Innovation Systems

Research sphere	*Industry sphere*	*Government sphere*	*Donors' sphere*	*Social acceptance*	*International organisations*
— University-university — University industry — University research centres — University-industry-research centres	— Industry-industry — Industry market — Industry-university — Industry-Government	— Compliance R&D support — Prevention of resources-diversion — Innovation diffusion within national boundaries — Innovation Diffusion abroad — Training of regulators	— Donors-government In LDCs — Donors-NGOs — Donors civil society	— Civil society — NGOs — Press and Media	— Setting International regulations — Diffusion of standards and best practices — Incentive system

Source: The author

In the future, innovation policy may extend beyond these traditional sectoral domains if "third-generation innovation policy" integrates the innovation needs of all domains that can help to advance industrial development. The obvious candidates for such a mix are environmental policies and other key policy domains for sustainable development that are in need of new technological and organisational solutions. It is important to recall that innovation policies, as well as sustainable development policy domains, are continuously evolving.

The questions that remain pending relates to the relationship between firm-based innovation and sustainability sensitivity, and a more macro-economic decision requiring public policy making and collective choices.

The dialogue is not easy between the various actors involved and various spheres, when innovation systems or part of them are devoted to sustainability. Research efforts and sustainability oriented innovation systems can be seen as a way of diverting valuable resources from market-oriented innovation efforts and world competitive pressures. For R&D to address the challenges posed by sustainability, several studies confirm the great need to strengthen the "demand" side of the dialogue between experts and decision makers involved in action programmes for sustainability. Another acute need emphasised is for the creation of bridges across spatial scales, so that the location-specific needs and knowledge central to sustainability can be linked with relevant national and international level R&D (Folke et al., 2002).

The difficulties of the collective effort for sustainability in Africa

The issue of innovation and sustainability in African countries raises several questions. This is as a result a weak knowledge base, incomplete innovation systems and often

weak sensitivity to sustainable development gains. As remarked elsewhere, these issues may seem as luxurious concerns in a continent where there is poverty, hunger, illnesses and disease and conflicts. However, there are several motives for African countries to innovate for sustainability. When examining the linkages between innovation and sustainability, in an African context, it becomes clear that new opportunities exist for African development, as much as some risks.

First, this is because upstream they suffer from a limitation of resources;, this requires using those resources in a very frugal manner and not having heavy environmental costs they are unable to bear. This would guarantee future generations access to a certain amount of these resources.

Second, they also need to innovate because of the many problems they suffer from that have proved difficult to resolve using conventional techniques and approaches. Innovation has to be in all fields and not simply in the technical field: in the social field, in the political field, and in the organisational field. Water diseases, for example, result not only from lack of water purification techniques, but also from the way water is collected, transported, stored and distributed. We have highlighted some of the weaknesses facing innovation systems in LDCs looking specifically at Middle East and North African (MENA) countries in previous contributions (Djeflat, 2000). It is also quite clear that all components of innovation systems have to be replaced within that specific context of under-development. However, current endogenous capabilities of African countries depend very much on the extent to which they have access to advanced technology, and to the extent that this technology is effectively transferred. African countries find themselves in an uncomfortable situation where concerns for environmental protection and sustainable development are fully transferred, where regulations are also transferred, mostly with the help of international organisations, but where the means, i.e. the technology, is not transferred or transferred only partially. This situation will have important implications for innovation and knowledge dynamics, and raises the question to what extent sustainable development can take place without sustainable knowledge (Djeflat, 2010).

While all these motives to drive African countries to innovate for sustainability exist, there are also several impediments.

The first and most important impediment includes the cost to the environment. This does not seem to be strong enough to have a significant impact and is usually externalised at the firm level. It does not constitute a strong motive to undertake innovative activities in this sense. This situation is found in the mining sector in Latin America (Warhurst, 2000), and can easily be found in the oil sector (Algeria, Nigeria), in copper mines (Zambia), and in the phosphate industry (Morocco) (El Khabli, 2001).

The second impediment is the force of the regulations that should normally be a driving motive. In an African context there are several obstacles due to governance problems and the widespread corruption in the judicial system in particular.

The third motive relates to social pressure that is relatively weak. The communities and villages most affected by pollution, environment hazards and non-sustainable

behaviour do not have sufficient knowledge to understand the problems. Moreover, they have no voice at the political level to express concern and put pressure on polluters to undertake technical or organisational innovation. Examples from the oil sector in Algeria show that major oil companies started changing their attitude and being more concerned with pollution control and environmental protection only when their key technical personnel became involved; they started exercising pressure when they felt personally at risk. Pressure could not come from villages and populations living in areas that were polluted as a result of flared gas and severe air pollution.

The fourth impediment is pressure from international organisations. In the current situation, this factor seems the most plausible factor to have a significant impact on Government and firms to change their technologies and organisations to more responsible behaviour. However, two major obstacles can reduce its impact. The first is the limited financial means of many debt ridden African states; this means that they cannot divert precious resources to innovation while other urgent needs are not satisfied. International public funding can play an important role in this respect. The idea of credit conditionalities by international organisations for environmental protection is put forward (Warhurst, 2000); for African countries, however, this may have a counter-productive effect. It could lead to a drawback in sustainability, inasmuch as it could result in less investment for poverty reduction, health protection and education promotion investments. The second obstacle is, of course, the limited technological capabilities.

The fifth impediment coming from donor organisations has had a non-negligible impact in recent years. This was the case in the agricultural sector where some progress has been made using local competencies in R&D to find local solutions to problems such as crop disease, water treatment or water-saving irrigation techniques. Other success stories are found in the field of micro finance, although they are unfortunately far too limited and most certainly not sufficiently publicised. The manufacturing and the industrial sectors have benefited much less from strong support to innovate coming from international donor agencies. Therefore, the issue of sustainability in relation to innovation systems has not been fully explored in a developing country perspective.

PPP and the Promotion of Sustainable and Innovative Industrial Models in Africa: Some Recommendations

As stated in Objective 17, a full range of measures are needed, including financial support and debt relief, the transfer of technologies and scientific know-how to developing nations on favourable terms, and the establishment of an open, non-discriminatory and equitable trading system to help developing nations increase their exports.

Government action will need to set a clear direction; this should include review and monitoring frameworks, regulations and incentive structures that attract investments and reinforce sustainable industrial development and innovation. National oversight

mechanisms such as supreme audit institutions and oversight functions by legislatures should be strengthened.

Urgent action is needed to mobilise the massive capital of private finance and knowledge to implement sustainable industrial development and innovation objectives. Long-term investments, including foreign direct investment, geared towards critical sectors in Africa are needed. Several PPP arrangements should be developed.

There is a need for new orientation of economic and institutional reforms to cater for the needs of foreign capital and trans-national corporations who are sensitive to sustainable domestic growth and industrial development. This should be done by creating a friendly business environment in the sense of PPPs.

In the area of environmental protection, there are grounds for a "new type of technology transfer" to take place. The new forms of technology transfer in environmental management embraces the knowledge, expertise, and experience required to manage technical change of both an incremental and a radical nature. This also includes the development of human resources for implementing organisational change to improve overall production and energy efficiency, and environmental management throughout the plant and facility. Technology transfer and technology partnership through joint ventures or strategic alliances are ways of building up technological and managerial capabilities, and capabilities for innovation and sustainable industrial development. This is particularly pertinent to Africa, although such strategic alliances are emerging in all the major mineral-producing countries (Warhurst, 2000). For this transfer to be effective, however, a substantial increase in the technological capabilities of African countries is required (Barnett, 1992).

There is a need for African countries to tap into global knowledge geared towards sustainability: this opens up the opportunity for African countries to improve their relatively weak local knowledge base and to extend their knowledge system to include their diasporas, as shown by the successful stories in India, China and South Korea.

The opportunities offered by ICT give a new perspective. ICT inclusion into the knowledge system gives the opportunity for local firms and research institutions to integrate knowledge networks, update their often obsolete knowledge, and sometimes have access through their diaspora, indirectly and often discreetly, into the knowledge systems of more advanced countries.

All these factors are at the origin of the "sustainability divide" and "sustainable divide" that are taking place in development and growth.

REFERENCES

Barnett, A. (1992), *The role of industrialised countries in the transfer of technology to improve the rational use of energy in Developing Countries*, A contribution to the 1992/1993 COPED Network Research Programme, SPRU, University of Sussex, Brighton, UK.

DESA (2016), Public-Private Partnerships and the 2030 Agenda for Sustainable Development: Fit for purpose, *DESA Working Paper* No. 148 ST/ESA/2016/DWP/148.

Djeflat, A. (1975), *Noise pollution and noise control: opportunities and threats for equipment producers*, mimeo, School of Management, University of Bath, GB.

Djeflat, A. (1996), Les technologies de l'Environnement: des perspectives durables de partenariat Euroméditerranéen *Reflets et Perspectives*, Vol. XXXV, No. 3, pp. 297–312.

Djeflat, A. (2000), National Systems of Innovation in the MENA Region, World Bank, Washington DC, 52pp.

Djeflat, A. (2008), Innovation takes off through industrial technical centers in Maghreb Countries: a missing link in NSI or new opportunity? International Conference GLOBELICS MEXICO, 22–24 September 22–24.

Djeflat, A. (2010), Sustainable knowledge for sustainable development: challenges and opportunities for African development, *World Journal of Science, Technology and Sustainable Development*, Vol. 7, No. 2, pp. 131–49.

Djeflat, A. (2005), Innovation systems, knowledge economy and sustainable development: challenges and opportunities for African development. The fourth Globelics conference, Trivundrum, India.

El Khabli, A. (2001), *R&D and innovation system in the phosphate industry in Morocco*, PhD thesis, The University of Lille 1, France.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S. and Walker, B. (*2002*), Resilience and *Sustainable* Development: Building Adaptive Capacity in a World of Transformation, *ISCU Series on Science for Sustainable Development* 3, pp.1–72.

Lundvall, B.A. (1992), *National Systems of Innovation: An analytical framework*, Pinter, London.

Rodrik, D. (2006), *Industrial Development: Stylized Facts and Policies Revised*. 2006. Copy at http://j.mp/2oz4ySE.

Rothwell, R. (1992), Industrial innovation and government environmental regulation: some lessons from the past. *Technovation*, Vol. 12, No. 7, pp. 447–58.

Tilton, J.E. (1992), *Mining Waste, the Polluter Pays Principle, and US Environmental Policy*. Colorado School of Mines, Department of Mineral Economics, Golden, CO. Working Paper 92–8, October.

Warhurst, A. (2000), *Environmental Regulations, Innovation and Sustainable Development*, IDRC books free online, 9–12 September.

BIOGRAPHY

Professor Abdelkader Djeflat was appointed full Professor in Economics at the University of Oran in Algeria in 1992, where he held the position of Dean of the Faculty of Economics, Chairman of the Scientific Council, and member of the Scientific Board of the Centre of Applied Economics for Development (CREAD). He currently works at the University of Lille in France, where he teaches industrial and development economics, and is Senior Fellow at the Clerse Laboratory (CNRS). He is the founder and current Chairman of Maghtech (Maghreb Technology Network) (Maghtech.org), and a member of the Constitution Committee of the Globelics Network. He was involved in various tasks with the Ministry and National Economic and Social Council (CNES) of the Algerian Government. He has undertaken extensive consultations with various UN organisations, ECA, ESCWA, UNDP and World Bank Institute. He has written several books and articles in various international journals. He holds a PhD from the University of Bath in United Kingdom.