INTI JOURNAL | Vol.2023:16
eISSN:2600-7320

Relationship Between Change and Development in Environmental Engineering Education in Libya

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Abstract

This study is designed to present an overview of the state of the art on new capacity-building approaches and methodologies to meet the demands of sustainable development at global, regional, national, and local levels. A brief description of current barriers to integrating sustainability into engineering education demonstrates how New Libya is playing a vital role in effective education and training in environmental engineering using the teaching and learning practices employed in green engineering courses and the best practice UNIDO PRIME & GRIP, UNESCO MAB and MOST blended learning approach that helps level the varied content knowledge, expertise, and experience of professionals. It highlights a strategy and plan of action to meet the challenges of change and development in education and training required to develop the vital skills and experience of sustainable development professionals needed to perform their more sophisticated jobs with greater coordination and prioritization among aviation stakeholders. Finally, it provides a framework approach using outcomes, output, baseline, targets, performance indicators, and activities to design a wide range of formal education and training in environmental protection fields using new blended learning technologies for the enhancement of sustainable livelihoods in general and Libya in particular.

Keywords

Sustainable Development, Green Engineering, Framework approach, Education & learning technologies

Introduction

Libya's National UNCSD Rio+20 Report for June 2012 highlights its commitment to the future we want (Bindra, 2012). New Libya has recently been impacted by a year-long crisis of war. The country is ecologically vulnerable, with fragile ecosystems subject to drought and desertification, rapid coastal erosion, and chronic water stress in certain regions. Being a single commodity trading country, it is also economically vulnerable, with an economy based on a single export: hydrocarbons (oil and gas). This twofold vulnerability is a challenge that the New Libyan Centers for Learning and Research are addressing by adopting an inter-sectoral approach and refocusing public policy planning and technical capacity building on adapting to climate change, combating desertification, and preserving biodiversity and water resources. To

Submission: 2 June 2023; **Acceptance:** 3 July 2023

limit global warming to 2%, countries would have to reduce their greenhouse gas emissions by at least 40% between 2013 and 2017 (Bindra et al., 2015).

Considering the above, it is apparent that education and training for environmental protection and a healthy livelihood in Libya are at the threshold of their biggest days. Their new forces, environmental determinants, communication and information technologies, problems, opportunities, expectations, and needs are shaping it. Despite enormous progress in many areas of human endeavor, Libya is beset with tremendous problems and challenges, like today's world. It is dominated by rebuilding the conflict-impacted infrastructure, strong population growth, frequent outbreaks of conflicts and ethnic strife, hunger, disease, persistent poverty, homelessness, long-term unemployment, and ignorance, as well as problems related to the protection of the environment, securing peace, democracy, respect for human rights, and the preservation of cultural diversity. Current international trends are characterized by a series of concurrent and sometimes contradictory forces like globalization, democratization, regionalization, marginalization, polarization, and fragmentation (Bindra et al., 2013).

This study is designed to answer questions like: How can environmental education contribute to socio-economic change and help promote sustainable human development? How can education contribute to the organization of modern society, energy preservation, conservation, environmental protection, and lasting development? How can education respond to the changes from the autocratic old Libya to the new free and democratic Libya of modern energy management for graduates at their place of work and the civic culture needed to answer the challenges of change? What are the main trends, roles, and challenges of environmental protection and healthcare centres impacted by oil and gas exploration and production (E and P) management education? How can we improve and stay creative?

The answers to the above questions require in-depth knowledge and a deeper understanding of the current situation based upon an overview of the education and training system in general and environmental protection due to the impending climate change impacted by oil and gas consumption in particular in Libya, like other countries. It would help to scan the problems of the countries that have often borrowed standard models of environmental education, which pay little or no attention to country-specific issues.

In addition, this requires learning from some interesting case studies to demonstrate how today's education could have a far-reaching impact on tomorrow. A closer look at the outcome of the UNESCO reflection exercise on the roles, main trends, and challenges facing education shows that we are not concerned about an education system still tailored to yesterday when we should be deeply alarmed. Does the present study demonstrate that the novel approach adopted would not only help resolve complex issues but also answer questions like, "How do we solve the problems of today and tomorrow with the tools of yesterday? How can we educate tomorrow's environmental protection leaders to be more socially responsible? In response to these and many other challenges for the sustainable development of the desert, authors present recommendations from some new initiatives like Student Suggestion schemes, Staff Suggestion Schemes (SSS), Best Practice Programs (BPP), Curriculum development & Sustainable Energy for Economic Development (SEED) that might help introduce some new and inspiring concepts (Bellah et al., 2016).

An Appraisal of The Present Situation & State of Environmental Education & Training

In the current unstable, insecure, and difficult economic times, soon after the February revolution in Libya, the country has to look to the future. How far into the future do we need to look and consider? To prepare human resources for 2030, we need to examine past trends. Just think: 40–50 years ago, the size of a "small" computer was about a 10 x 12-foot room. Now a "small" computer might be in the "PDA" we carry in our pocket every day. It is not too early to consider what we need to do as educators and industry leaders to be prepared for 25–30 years from now (Mgerbi et al., 2012).

In the present, coping with the rapid growth demands requires a rapid expansion in the supply of trained personnel. This requires not only university-owned education and training but also the development of a great deal of expertise in vocational education and training and the development of qualifications based on occupational standards of competence, which are assessed in the workplace. This would help develop manpower capable of upgrading his or her skills, competencies, and values and/or acquiring new ones to survive in a global market where the main factor of competitiveness is human resources. This also requires knowledge and understanding of various branches of environmental science and engineering and the basic sciences—mechanical, chemical, civil, electrical, and industrial engineering; geology; chemistry; physics; health sciences; ocean sciences; and biology. Also relevant is the participation of specialists in the applied sciences related to environments, trade liberalization, economic development, architecture, and sustainable growth, as well as that of specialists in the social sciences and economics (Dboba et al., 2022).

Over 1 billion people or one-sixth of the world's population inhabit these deserts. Libya accounts for a land mass of which 950% is desert. Sustainable desert development in Libya under the umbrella of UNCSD Rio+20 Focal Point on Future Libya is a complex and evolving concept (Satya Pal Bindra et al., 2016). Defining sustainable development and envisioning how to achieve it on national and local levels poses an immense problem. Because sustainable development is hard to define and implement, it is also challenging to teach. There are several issues facing desert communities and the mandate for eco-systems: the use of water and other resources, the maintenance of biodiversity, and the recycling of waste minimizing the physical deterioration of the environment, especially in an oil-producing country like Libya have created a strong international demand for knowledge about developing the economies and living sustainability in desert regions. Meeting the international obligation under UN Convention on Desertification requires developing education and training programs, especially in the field of energy health & environment (Emelie, 2020). The overall Desert Knowledge http://www.desertknowledge.com.au) is categorized under the following three 3 major focus areas:

- SUSTAINABILITY — Developing processes that enable the enjoyment of a quality of life that is in balance with the maintenance and enhancement of the local and global environment.
- HARMONY — Developing processes for effectively engaging modern style and indigenous communities that lead to harmonious and successful economic and social advancement for all groups.
- WEALTH-CREATION Developing viable businesses and employment opportunities capable of supporting an internationally competitive lifestyle for the people of the desert.

Education and training in environmental protection for desert development, in particular, are viewed by some as education for sound environmental management based upon rational exploitation of resources using principles of equity and social justice, personal development, and preparation for professional lives. Others feel education is meant for developing civic and personal qualities and awarding academic and professional qualifications. Yet others feel education is meant to develop students' intellectual capacity, and ethical and moral values to allow them to deal with issues about energy management related to technological, economic, and cultural change and diversity. Some feel that education is needed to prepare the fittest-thinking workforce for the future. The future belongs to the fittest that can Develop the Desirables and Eliminate the Undesirables (DDEU) (Bindra et al., 2013).

Education must equip the future workforce and best brains with qualities such as initiative, entrepreneurial attitude, and adaptability and allow them to function with greater confidence in the modern-day work environment. To develop best practices in education and training, authors reviewed the outcomes of various initiatives launched during the first AU Conference of Ministers Responsible for Electricity, which took place in Addis Ababa, Ethiopia, from March 20–24, 2006, under the theme "Common Vision and Strategic Framework for a Continental Policy." It helped in deciding on the agreement to work together to realize the continent's energy potential, particularly in hydropower as a major renewable energy option, and to establish an African Fund for Electricity with an emphasis on rural electrification (Reporting Services, 2008). The authors also examined the Declaration of the First Africa-South America Summit in Abuja, Nigeria, on November 30, 2006, on cooperation issues to give priority to establishing interregional partnerships and promoting South American investment in African renewable energy resources, such as hydro, biofuel, solar, geothermal, and wind energy. We have also looked into the Cairo Declaration on African Cooperation and Solidarity, held in Cairo, Egypt, from 11–15 December 2006, i.e., the first AU Conference of Ministers Responsible for Hydrocarbons adopted the Cairo Declaration on African Cooperation and Solidarity (AU/EXP/OG/DecI. (I)) and an associated Action Plan (AU/MIN/OG/ Pl.Ac. (I)). It has helped to define and implement development strategies for clean and renewable energy, particularly hydrocarbons, while the action plan elaborates policies and strategies for the development of renewable energy, namely biofuels. At the conference, ministers also agreed to set up, under the auspices of the AUC, a permanent Conference of African Ministers Responsible for Hydrocarbons as a continental coordination body for policies and strategies in this field. To develop capacity-building needs, we find that the Eighth AU Summit Declaration on Climate Change held in January 2007 adopted decisions on, inter alia: climate change and development; implementation of the Green Wall for the Sahara Initiative; and the strengthening of research and development, particularly in renewable energy, forestry, and agriculture, to increase the continent's resilience and adaptation to climate change (Bindra et al., 2014).

A ministerial declaration adopted at the summit encourages the transfer of relevant climate-friendly technologies within and among developing countries. An Africa-Europe Energy Partnership meeting that took place in Berlin, Germany, from March 6–7, 2007 highlighted the need for access to modern, affordable energy services as a key to sustainable development and attainment of the MDGs. It emphasized the need to improve energy services to meet basic needs and generate income in desert areas. The Partnership was formally launched during the EU-Africa Summit, in November 2007, and is endorsed by FEMA and the EU General Affairs and External Relations Council (Der et al., 2005).

The Tokyo International Conference on African Development (TICAD) Ministerial Conference on Energy and Environment for Sustainable Development, held from March 22–23, 2007, in Nairobi, Kenya, aimed at sharing experiences and lessons learned in Africa and other regions and identifying effective ways to address key energy and environment issues in the context of sustainable development. The meeting emphasizes that clean energy development has great potential for the private sector, including for new businesses in off-grid and community energy systems in areas such as biofuels and low-cost, off-grid lighting products.

African ministers convening under FEMA met in Maputo, Mozambique, from March 28–30, 2007, and adopted the Maputo Declaration on Energy Security and Sustainability in Africa. In the declaration, Ministers identified the need to: • increase access to modern energy services and address the significant negative health and environmental implications of heavy reliance on traditional biomass energy; • utilize Africa's rich energy resources, which are currently underexploited or exported without benefiting the majority of Africa's citizens; • increase financial flows to match Africa's energy investment needs; and • promote a better mix of energy supply options, ranging from existing conventional options to renewable energy sources, to strengthen Africa's energy security. The Brazilian experience in biofuels shows that biofuels can help to achieve energy security, promote agricultural development, increase employment opportunities, protect the environment, and reduce greenhouse gas emissions. The impending energy crisis due to the depletion of fossil fuels suggests an urgent need to find substitutes that can meet both energy demands and the needs of the rural poor. The reasons for this interest include high and volatile oil prices; opportunities for job creation in rural areas and for revitalizing the agricultural sector; the availability of new and more efficient biomass technologies; and the need to address global environmental challenges (Bindra, 2008).

Noting that Africa is increasingly seen as a potential major player in the field of biofuels, policymakers need to develop appropriate policies and strategies for sustainable biofuels development. This shows that bioenergy is an emerging international priority and is capable of addressing the triple challenge of achieving food security, energy security, and sustainable development. There is an opportunity to harness Africa's vast biomass resources, along with the continent's challenge to transition from traditional to modern bioenergy. However, it is felt that sustainability should be the key element of biofuels development and requires global standards on biofuels, including concerning full lifecycle analysis, labeling, and clarification. An overview of the energy situation suggests that renewable energy, especially biofuels, could make a substantial contribution to reducing energy import costs, environmental protection, and promoting rural development. There is increased potential and efforts in the area of biofuels development, including its recent biofuels strategy, which underscores the importance of considering the environmental impacts of biofuels and of creating commercial opportunities in the biofuels sector for farmers. The global fight against poverty needs to address the "energy poverty" question by recognizing the importance of sustainability in biofuel development. It shows the need to: create a better policy climate; develop both first- and second-generation biofuel technologies; and add value to African commodities in international markets. UNIDO's initiatives, including the development of an interregional bioenergy network and the African Union, have shown how the political will, expressed at the first Africa-South America Summit, to promote South-South partnerships for biofuels development, along with the decision taken at the eighth AU Summit to develop a new renewable energy policy and strategy for Africa, provide a way forward (Bindra & Lahmer, 2002).

In solidarity with the United Nations-sponsored Global Campaign for Education that ended on July 1, 2000, aimed at increasing awareness and support for efforts launched through Education for All (EFA) 2000 at the Dakar, Senegal, 26–28 April 2000 Conference. UNCSD Rio+20 Focal Point support for Libyan centres of learning initiatives in respect of education and training in general and energy and environment, in particular, has helped mobilize public opinion.

Libya feels that education must serve as a lubricant between individual societies and their needs. We are moving from a prevailing traditional model of education based on selective and concentrated learning and study for a limited period toward lifelong learning for all. This requires a sufficient, diversified, and flexible system of access to meet the challenges of a rapidly changing workforce. Graduates must be not only job seekers but also job creators (Shuaeib & Elarbi, 2008).

The relevance of environmental education is considered primarily in terms of its roles and place in society, and its function with a regard to teaching, research, and services. It must include matters like the democratization of access, accountability, and opportunities. It covers its mission, function, program, its content, and delivery system with respect for academic freedom and institutional autonomy, it should also include its participation in the search for solutions to pressing problems such as population, environment, peace, international understanding, democracy, and human rights (Lahmar & Bindra, 2008).

Quality is a multidimensional concept and must include the quality of the staff, programs, and students as well as the infrastructure and academic environment.

Internationalization is a reflection of the universal character of learning and research. It should be based on a genuine partnership and the collective search for quality and relevance in education.

As per a recent estimate, 70 to 80% of economic growth is derived from new or improved knowledge imparted through engineering curricula. In the year 2000, the contribution of technical progress to growth in Europe was estimated at between 25 and 50%—much greater in the high-tech areas. Unfortunately, only 10% of graduates in science and technology find jobs in the field in which they were trained. This shows that education and training curricula need to be revised to implement the impact of the changeover from the current system to the proposed system by identifying the impact, measuring the impact, evaluating the impact, and communicating the impact to interested parties. It is hoped this changeover will be carried out harmoniously to set the agenda for guiding the destiny of environmental management education through proposed initiatives like BPP, SEED, and curriculum development (Dboba et al., 2022).

Libyan Initiatives

Keeping the above in view, the UNCSD Rio+20 Focal Point Led Initiatives are dedicated to developing a new vision of "thriving desert knowledge economies" to meet the sustainable desert development challenges, such as the poorly developed manufacturing base, pastoral/mining principal industries, tourism as a growth industry, the diversity of the population, and high energy and transport costs—essentially, the "fragile" economy in a "fragile" environment. UNCSD Rio+20 Focal Point is engaged in reforming education and

training programs and has evolved a research agenda according to 4 major themes (Bindra & Salih, 2014).

- Theme 1 — Resource Management: Technologies for managing deserts, integrating indigenous and western perspectives, for more sustainable commercial land uses.
- Theme 2 — Community Visibility: Demand-responsive approaches to service delivery, applying cutting-edge innovation to meet the special health needs of remote desert areas.
- Theme 3 — Governance: Systems of management and leadership across agencies and/ or communities that help to use resources equitably and efficiently in desert areas.
- Theme 4 — Regional Integration: Understanding how to invest public and private resources in regional economies.

UNCSD Rio+20 Focal Point-led Libyan Centers of Education and Research (Satya Pal Bindra et al., 2016) are joining a global network in seven knowledge clusters of expertise, operating as a networked innovation system of interaction, and focused as follows:

1. Desert Peoples Centre: This Centre is aimed to focus on capacity building among indigenous peoples. It is a joint initiative of the UNCSD Rio +20 Focal Point-led education & research centers with the Arab desert center and Sebha University-based Centre for Appropriate Technology, and the EU framework for desert Development research project with a focus on the development of an indigenous education provider.
2. Graduate Desert Knowledge University: Government and non-government agencies have a high level of scientific and technical expertise that facilitates several undergraduate and graduate students. This project will seek to coordinate and further enhance these programs.
3. Sustainable Communities - Living Together in Arid Lands: By integrating economic, social, and healthy environmental issues this Project is designed to ensure effective regional outcomes that will improve wellness and quality of life. The project focuses on how local and remote communities together with the diversity of industries - including tourism and art - can achieve productive outcomes.
4. Technical Services Project: Deserts are challenging environments that require innovative solutions to infrastructure development, efficient energy use, and achieving a high quality of life. The physical infrastructure and technical services for desert communities are to be improved through the use of expertise in materials testing, building, and construction, water, and energy use, waste disposal, transport, health, wellness, personal development, and communications.
5. Natural Resource Management Project: Most of the desert area in Libya is held in pastoral, agricultural, and oil & gas fields. A high level of expertise is being developed in ecologically sustainable production from these lands. This project is designed to focus on environmental management and resource development issues looking after desert landscapes and creating healthy productive opportunities for them.
6. Health, Education, and Social Services Project: Libyan desert comprises small highly dispersed communities that involve a specialized remote delivery of health, education, and social services. This project focuses on delivering better social outcomes for people living in deserts; developing methods to use local expertise in broader related fields.
7. International Desert Innovation Centre: This key strategy is to provide the capacity for a desert knowledge economy in Libya by providing a range of services and network coordination through activities such as promotion and concept integration; marketing; packaging and managing desert knowledge; business incubation and networking. The

Centre with the support of UNCSD Rio+20 Focal Point Libya is engaged in investigating and developing innovative solutions to issues and problems in managing arid lands at a global level. It is seeking partnerships and alliances with key international agencies.

Even more challenging is the task of totally reorienting an entire education system to achieve sustainability. With the cooperation of the UNCSD Rio+20 Focal Point, successful national education campaigns are now including a complex range of environmental, economic, and social issues that sustainable development encompasses. In preparing manpower to create and generate wealth for the future, we need to ensure that their education and knowledge include awareness of possible changes in demographics, technology, global challenges, leadership training, health and wellness, cultures, and more. This is not only assisting in placing education on a modern and sure foundation but also adapting successfully to rapidly changing times in the 21st century (Bindra, Soul, et al., 2015).

Discussion Of Results on Interesting Case Studies

A recent background informal survey through interviews of faculty, administrators, and students in some oil-producing countries, including Libya, on environmental education and training shows that there is no critical review (Mgerbi et al., 2012). There are no standards for measuring success. There are irrational programs. The educational environment is not creative or conducive to research. Most students believe that creativity is not encouraged in society. Majorities do not like to seek the truth. They will hide information if necessary. Few are ambitious. A survey of faculty members shows that most of them do not think there is enough incentive or environment for research. The majority does not trust the administration. They think the lack of a research environment is by design. Very few took the initiative to enhance research. These surveys demonstrate that there is something wrong with our education system. The challenge is how to keep abreast of the latest developments (state-of-the-art knowledge). Most feel that what is required is providing the world-class full range of training needed by operators, including basic and technician skills, undergraduate and postgraduate education, as well as short specialized courses. This alone can help in environmental protection from climate change in an oil-producing country like Libya to adapt and adjust to a new changing situation (Bindra et al., 2015; Butlin, 1989).

An overview of the reflection exercise by UNESCO shows that there are clear trends that show physical expansion, differentiation, and fiscal constraints. The state of review shows that research studies on environmental protection from oil and gas industry-related subjects have been dealt with in many of the institutes, academies, universities, and institutes of the Economic & Social Commission for West Asia (ESCWA) regions (Lahmar & Bindra, 2008). However, the lack of financial support often seriously limits the scope of these studies. The ESCWA region does have a sufficient number of qualified personnel to deal with and solve problems involving less sophisticated technologies; however, such personnel in each country cannot hope to undertake research involving high levels of sophistication soon. They will require the cooperation of personnel with high-level specialized scientific and technical training in more than one ESCWA country. It is also true that many countries, particularly the smallest or least developed countries, cannot take up the environmental protection challenge individually, nor would it make sense for them to attempt to do so (Butlin, 1989).

These facts lead to the conclusion that conditions for possible and fruitful cooperation should be created in the ESCWA region, both concerning technology and the training of personnel. It appears necessary to set up advanced institutes, specializing in particular areas, in which professionals from all countries may receive sound and thorough training (Hennessy et al., 2015).

At present, most developed and industrialized countries are actively working to solve environmental problems with sophisticated and modern approaches. This might create in the future a new dependence on the part of ESCWA countries, similar to their dependence on energy technology up to the present. The only way that is most appropriate to avoid this problem is to initiate immediately the systematic training of scientists and professionals who will be required to carry out adequate research on the region's true desert environment protection from energy industry impacts (Renner et al., 2009).

Education: The educational subsystem needs to create awareness among primary and secondary school and university students of the environmental degradation, from climate change due to the overconsumption of fossil fuel-based energy problem that the world will soon face, and of the importance of making economic use of depletable fossil fuels (Tasquier et al., 2016)

The utilization of energy: a generation of young people educated to be aware of energy conservation and efficiency problems is certainly a great asset to a country in search of competent manpower (Bindra et al., 2015; Kandpal & Broman, 2014).

Training: The training requirements of environmental institutions should be systematically identified concurrently with manpower requirements. Each institution should be requested to prepare a training plan covering professional and technical staff development for incorporation into the environmental protection, energy, health, and education sector plans. Candidates for training should be carefully selected by the affiliated institutions. Training should be specific and, on the job, which could resolve any problems otherwise caused by releasing suitable staff for any length of time. Overseas training should be limited to higher-level staff who require specific skills for which training is not available locally. Environmental protection institutions should also plan for adequate training provisions, including updating the knowledge of the technical and professional staff (Smith et al., 2019).

Conclusion

This study presents current trends and new challenges facing environmental protection for desert development education and training in both developed and developing countries in general and in Libya in particular. It highlights the need to rethink its role and mission, identify new approaches, and set new priorities for developing the full brain potential of a productive workforce to tackle environmental degradation from climate change for future development. Current education and training programs must focus on developing a resource pack that takes a community-centred, skills-based approach to empowered learning to support the equitable involvement and engagement of the community of both genders. It shows how resources for dryland/desert are designed to address community-level vulnerabilities to chronic and sudden impacts of climate change and environmental degradation due to widespread oil exploration and production. It includes formal and non-formal activities and is designed to integrate practical guidelines for 'facilities-based solutions' such as renewable energy, tree planting, rainwater harvesting, and health care with a participatory, community-centred skills-based

curriculum. It includes program areas like system development, infrastructure, and information and communication. System development is vital to the exchange of ideas and experiences and the promotion of studies on policy issues. Infrastructure would assist in strengthening national research and development capabilities. Information and communication could facilitate access to databases and documentation. The curriculum must have special inputs so that students are not divorced from environmental and health affairs realities and goals of national building. It also outlines a basic rationale for curriculum development. After examining various factors that influence the planning and implementation of an effective curriculum, it makes specific recommendations on which the process of change and the development of environmentally sound oil and gas-related engineering education could be based and implemented. The objective is to set a strategy for the future curriculum design and propose an action plan to increase modernization, improve the quality of graduates, and reduce technology dependency.

The overview shows that a knowledge-based economy having characteristics of speed, quality, flexibility, knowledge, and the network has significant impacts and points in the direction of making universities and other institutions vital centers to promote human interaction and innovation, especially in the fields of integrated desert development and health care management. The success of these centres depends upon how much value we add at every point of service and program and how much we can be entrepreneurial, creative, flexible, and proactive to change in all aspects of management and operations. Collaborations and initiatives in the region are needed to avoid duplication or waste of efforts through Institute, Industry Interaction. The role model of best practice centres of excellence in education and research is briefly outlined to show the Best Practices Programme forming part of such a strategy.

The necessity of viable lessons learned from initiatives like curriculum development is undeniable. Lessons learned have immense potential to develop and use system models to make better predictive models for their application in healthy desert development, energy industrial establishments, and oil and gas management. Finally, the paper shows how access to modern, affordable low-carbon energy services with adequate environmental protection is a way forward and can serve as a key to sustainable development and the attainment of the MDGs. It emphasized the need to improve low- or no-carbon energy services to meet basic needs and generate income in desert areas.

Conflict of interest

The authors declare that there is no conflict of interest in this study.

Acknowledgments

Not applicable.

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