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Innovating the built environment to accelerate sustainable development – the Integrated Habitat Approach

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Abstract

The Universal Sustainable Habitat Development (USHD) is an integrated infrastructure development platform. Habitat in this instance refers to the built environment, apropos sustainable community buildings that meet their constituent needs through provision of integrated renewable energy technologies within the fabric of the building. Widespread stakeholder consultation has transformed USHD from a verbal model into a series of implementable collaborations that emphasise the need to incorporate not just the equipment into resilient buildings but also conduct long-term monitoring, evaluation, research, training and education programmes.

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Keywords: Africa; sustainability; renewable energy; integration.

1. Introduction

The USHD is a multi-disciplinary, multi-sectoral project, conceived by Green Globe Architecture (GGA), for sustainable development that involves building new, or rehabilitating existing, community structures (schools, community centres, health centres, domestic housing, sports grounds etc.) and providing such infrastructure with a suite of integrated renewable energy resources to facilitate a sustainable environment for the buildings' constituents.

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The USHD programme is being designed to catalyze the implementation of several global agendas including the Sustainable Development Goals [1], the United Nation (UN) Assembly's 'Decade of Sustainable Energy for All' (2014-24) [2], the Global Environmental Facility Programming Strategy on Adaptation to Climate Change [3], the UN Environment Programme Green Economy initiative [4] and the World Health Organisation's Public Health and Environment Strategy [5].

The principle objective of the USHD is to test whether these agendas can be served through a single utility. To undertake this objective, we have considered how existing technologies and resources that have been tried and tested but are rarely integrated could be brought together under one roof to provide socio-economic prosperity to resource-poor communities in Sub-Saharan Africa. Fig. 1 conceptualises the USHD as an energy-driven self-sustaining infra-system [6] that generates a strong economic foundation through supplying renewable energy to various societal domains that underpin and support each other. The USHD concept is centered on the principle that considerable economic savings can be made over the whole life-cycle of a building, if the architectural basis of that building adopts green-building principles and uses renewable sources for the majority of its energy needs.

The broader aim of the USHD is to create new opportunities to facilitate development across a number of domains simultaneously, to accelerate the general wellbeing, social and economic empowerment of target communities who are resource-poor. To achieve this aim, we suggest to incorporate a multi-disciplinary and multi-sectoral programme of Monitoring, Evaluation, Training, Research and Education (METRE). The aim of the conceived METRE programme is that it will create a multi-dimensional array of data related to the inputs, outputs, outcomes and impacts of the USHD, achieved through collaborations across disciplines and sectors.

Some core components of a building based on USHD principles include:

- **Rainwater harvesting:** Guttering and pipes will collect rainwater and send it to a storage facility to serve the inhabitants.
- **Solar PV:** Photovoltaic panels will cover the roof space and deliver electricity to sockets throughout the facility.
- **Solar Thermal:** A fraction of solar panels will be used for the generation of hot water.
- **Heat Exchange**: Mechanisms for ventilation and air circulation will be embedded into the structure.
- **Anaerobic Digestion**: A facility for collecting, digesting and recycling waste will be included in each facility.
- **Building Materials:** The material used in the fabric of the building will depend on the outcome of discussions with stakeholder and the Buildings Research Establishment (http://www.bre.co.uk/) based in the United Kingdom. One option is to use a steel frame with compressed maize husks for the infill and partitions. Solar panels may have to be imported. Charge-coupling and inverter equipment may have to be imported. Storage of

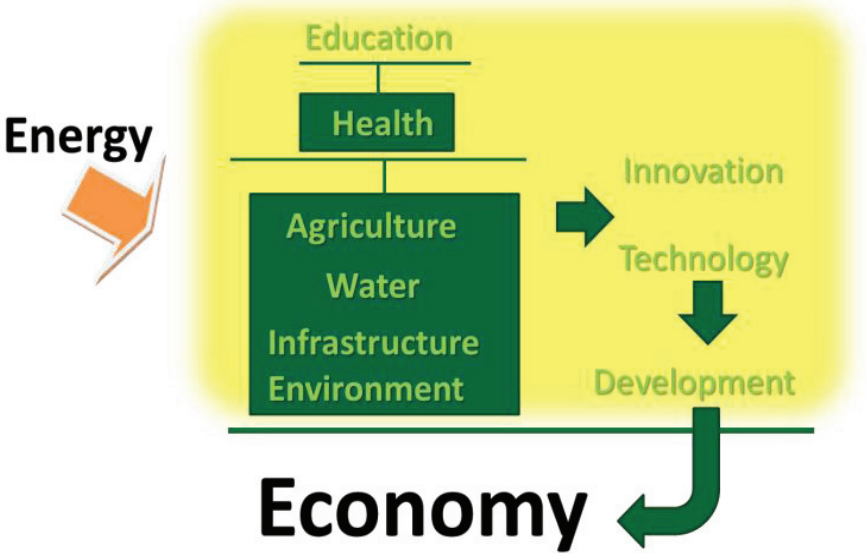

Fig. 1: Schematic illustration of community development as envisaged in the USHD. As energy is input to a self-supporting system with strong underpinnings amongst societal domains it generates forward momentum that leads to the strengthening of the economic foundation of the community.

electricity is likely to be battery-based with other options (e.g. water towers) to be explored during the design phase.

2. Methods

The USHD was initially conceived as a 'verbal model' that describes a form of building where many different types of renewable energy technologies would be integrated to provide sustainable benefits to the inhabitants. The model has been presented through mixed media (including architectural models) to high-level stakeholders from religious, political, academic and civil sectors in Sub-Saharan Africa to gauge how such a platform for sustainable development would align with current and emerging policies and strategies. The information gained from these stakeholder consultations has been used iteratively as the basis for developing specific implementation strategies of USHD including community centres, health clinics, energy facilitated market places, rural growth centres, housing and schools. At each point of the process, the concept of running a METRE programme has been introduced and discussed to gauge stakeholder interest and feasibility. We have also iteratively developed a 'theory of change' model [7] – described below - that captures many of the issues expressed as high priority by stakeholders. This model is being used as the basis for developing METRE programmes in specific countries and sectors. Being developed also, based on whole life-cycle modelling exercise, is a programme that will relate how facilities with energy supplied by PV compare to an equivalent system powered by diesel generators either in isolation or in combination with PV.

3. Results and discussion

3.1. Recent activities and stakeholder engagement

At the meeting of the 1st Ministerial Specialised Technical Committee on Education Science and Technology of the African Union (AU) held in Addis Ababa, Ethiopia in October 2015, the team developing USHD under the banner of the Botswana Green Energy Consortium received the AU "Best in Africa" Award for Renewable Energy Training as recognition of the innovation being undertaken in this sector. As a result of the award, GGA is now working with the Ministry of Education and Skills Development in Botswana, the Secretary General for Botswana National Commission for UNESCO and the UNESCO office in Germany on a Technical Vocational and Educational Training (TVET) delivery in the Botswana and Southern Africa Development Community (SADC) region. Wider implementation of this training programme is clearly of international benefit on the African continent.

Collaborative meetings have been held with New Economic Partnership for African Development (NEPAD) centred on the Science, Technology and Innovation Strategy for Africa 2024 (STISA – 2024) and the Programme for Infrastructure Development for Africa (PIDA) to enable implementation of the three development programmes. First and foremost, we are working with NEPAD to develop a proposal for a flagship programme for phase 2 of the implementation of the STISA -2024 programme. This proposal will focus on how the USHD can form the hub of a wider programme of research, development, innovation and enterprise supporting a multi-dimensional evidence base. This will in turn support individual countries to evidence-based policy across various domains related to in-country priorities of sustainable development that fully utilise innovative renewable energy technologies.

The practical implications of USHD will be fully realised when implementation and research protocols are initiated. We are now working on North–South and South-North knowledge transfer to enable technological innovation and research for the benefit for both hemispheres. Currently, the USHD stakeholder network involves; SWAP Botswana, Videre Global, National Technical University of Athens, Durham University, Newcastle University, University of Pretoria, Botswana International University of Science and Technology, Lilongwe University for Natural Resources and Agriculture, Botswana Innovation Hub and the Francistown College for Technical and Vocational Educational Training. The teams above form the Botswana Green Energy Consortium that is overseeing the implementation of the programmes outlined in this paper.

3.2. Theory of Change and the METRE programme.

Stakeholder interest in the USHD has been captured qualitatively and used to identify pathways towards physical implementation. One of the key messages shared by stakeholders is the need for any intervention to provide cost-effective impact in terms of development. However, before we can place a value on such impacts, we need to identify the expected impacts in detail and estimate their size. This is being addressed through a theory of change approach [7]. In essence, this involves a careful description of the process through which the proposed initiative is expected to deliver the desired impact(s). The building blocks of this process are illustrated in Fig. 2. Briefly, they can be defined as follows:

Inputs All components and services of USHD that result in a product and can be measured as an output
Outputs The resulting products of the inputs
Outcomes The short to medium-term effects of the outputs that result in measurable state-changes within a population
Impact The longer-term, population-level consequences associated with an outcome

4. Conclusions

A major challenge around accessing energy in Africa has been a reluctance of the sector to invest in infrastructure with relatively high up-front capital investment [8], Governments' lack of capacity to finance such developments [9] and at times a lack of visibility and credit of the renewable energy technology sector [10]. As such, securing investment to grow business and encourage entrepreneurship in these areas is a major challenge for the rural Sub-Saharan Africa setting. It is for this reason that associates need to be sought as investment partners to implement integrated infrastructure development in Sub-Saharan Africa. This support is critical because micro-grids have a high up-front capital cost that requires financing. The investment that could be attained could help further demonstrate the innovative nature of the USHD model and attract interest that could generate loan facilitation to institutions in Sub-Saharan Africa who have already acknowledged the benefits of introducing renewable energy technologies in the rural and peri-urban areas.

In the case of the possible future development, the important focus for the USHD concept will be on demonstrating how the implementation of the project could lead, for example, to improved livelihoods (because of a

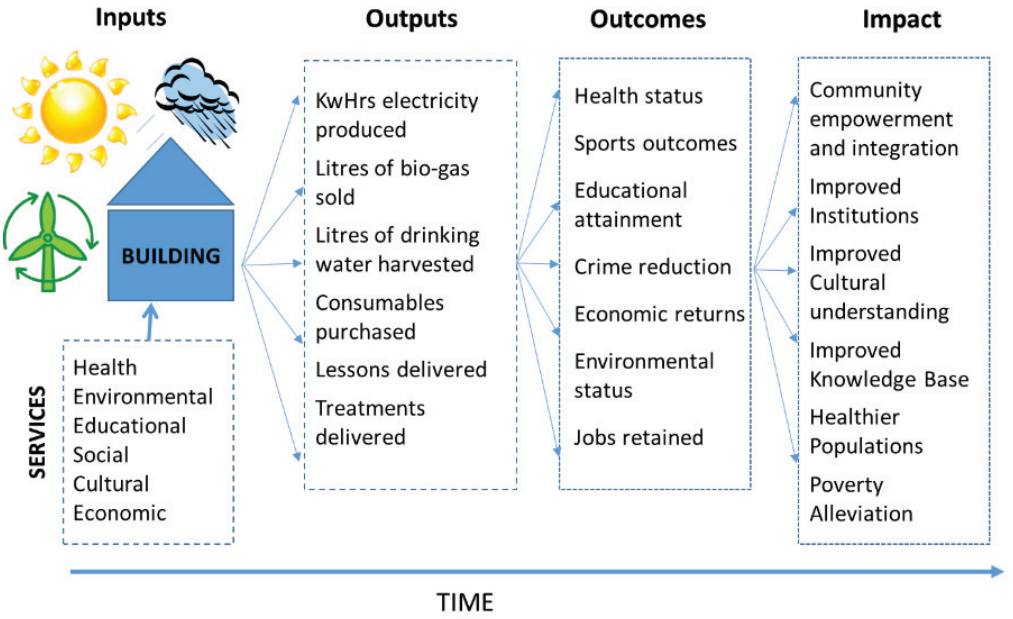

Fig.2. Illustrative examples of the domains and building-blocks contained within the USHD theory of change model.

greater willingness to invest), the retention of skilled workers (by reducing the incentive to migrate to other regions/countries) and, improved living conditions.

In conclusion, the USHD is an integrated infrastructure development platform that has been endorsed by a wide range of stakeholders from often disparate sectors. Adoption of the principles underpinning the USHD is increasing as evidenced by willingness of the AU and other major stakeholders to engage and integrate the USHD into their ongoing efforts to improve the lives and economic circumstances of African populations. The 'universal' nature of the concept has therefore been confirmed. The 'sustainable' aspect of the USHD is seen as a key by many stakeholders to its eventual success as it aligns with many governmental and international policies.

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