Research for Development

Oscar Eugenio Bellini · Andrea Campioli · Claudio Del Pero · Cinzia M. L. Talamo · Davide Chiaroni · Stefano Guidarini · Camillo Magni *Editors*

Innovative Approach for the Development of Sustainable Settlements in East Africa

Affordable Housing for Mogadishu

Fondazione Politecnico di Milano

Springer

Research for Development

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Foreword

BECOMe: A Bet and an Act of Reciprocal Trust

Over the past decades, the role of Academia in the complex field of Cooperation and Development has seen a major evolution and recognition. Universities are indeed capable of producing innovation and high-level knowledge, suitable to find solutions during emergencies as well as support strategies with a long-term vision, making them the main driver of science diplomacy, a qualifying element of the European Union foreign policy designed to meet the shared needs of development and equity.

This is the context in which Politecnico di Milano Cooperation strategy and initiatives are activated, with an approach that enhances scientific knowledge and skills and puts people back at the center of innovation processes, as globally required by the 2030 Agenda of the United Nations and Agenda 2063 of the African Union. At a national level, Law 125/2014 recognizes the academic world as an actor in the system of development cooperation. The efforts of Academia to enrich its traditional missions of teaching and research are therefore encouraged. In the last 15 years, our university has refined its own vision, giving origin to a more specific elaboration of its efforts linked to the valorization of the different polytechnic competences and the institutionalization of Cooperation towards a progressive alignment with the international reflections.

Sustainable and affordable urbanization is one of the most pressing issues for the global community and it also stands at the core of BECOMe (Business ECOsystem Design for Sustainable Settlements in Mogadishu), an investigation into innovative approaches to build sustainable settlements in Mogadishu. The research discussed in this publication was conceived in 2018 and initiated in 2019 with the aim to deliver an integrated development plan for a business ecosystem based on the co-existence of affordable housing, local entrepreneurship, social facilities, and renewable energies as an enabling factor of the sustainability of modern settlements. In line with the approach to Cooperation at Polimi, BECOMe starting point is the belief that complex issues should be approached from a multidisciplinary perspective.

BECOMe contributes to the mission to build an academic institution committed to dialogue with society and capable of serving communities by addressing major social issues. Since 2005, the vision on the role of Politecnico di Milano in the ever-evolving field of Cooperation and Development has been refining, giving way to an alignment with the national and international frameworks. Politecnico di Milano has institutionalized its vocation for Academic Cooperation, which originated from the commitment of individual professors who, over time, laid the foundations to build an institutional interest.

Among the over 100 Cooperation initiatives mapped within our university from 2010 to 2021, projects involving one or more African countries are around three times more than those involving Asia and six times those involving Latin America, showing a well-defined interest in working with African partners. A recent in-depth mapping revealed that the projects activated in the past 10 years involve 25 African countries, with 70% of the total represented by 10 nations: Mozambique, Tunisia, Egypt, Kenya, Ethiopia, Morocco, Senegal, Somalia, Tanzania, and Algeria. The number of initiatives in collaboration with African partners tends to increase every year.

In accordance with Politecnico di Milano tradition, collaborations developed with African universities and research centers prevail, but a share of partners from the private sector and national institutions is in constant growth. Partnerships and networks lead to the development of a constructive and continuous dialogue between universities and the outside world: these partnerships guarantee an effective and efficient impact on Cooperation and Development strategies at both national and international levels. Additionally, acting in synergy with a variety of stakeholders facilitates enhancing the technical, scientific, and innovation contributions intrinsic to our university, and such approach will help Politecnico di Milano to further consolidate its institutional commitment. The latter can be synthesized in three strands of work, sometimes interlinked:

- Higher Education and Capacity Building
- Research for local Development
- Science Diplomacy

Within this framework, more than 50% of Higher Education and Capacity Building projects focus on Africa, as well as over 60% of Research for local Development initiatives, while 100% of Science Diplomacy actions involve the Continent.

It is worth mentioning that BECOMe is part of a growing portion of Cooperation and Development initiatives activated by Politecnico di Milano that are self-funded by our university through the competition Polisocial Award in support of scientific research with a high social impact. The Award is made possible by the 5 per Mille IRPEF funds and promotes projects in a variety of scientific areas at Politecnico di Milano, involving all 12 departments. Since its creation in 2013, a total of 46 projects have been funded, 18 of which are in cooperation with developing countries. The initiative, which is unique at the national level, has strengthened several constructive interactions between Politecnico di Milano and the outside world, focusing on a combination of traditional forms of knowledge transfer and a "horizontal" exchange with stakeholders.

One of the common traits of the Polisocial Award projects is the attempt to tackle needs identified outside of the academic realm: university research is enriched by such an approach and becomes a practice of Cooperation, based on scientific evidence, characterized by inter-actor dialogue and mutual learning.

The Award has strengthened a culture of university-society collaboration with numerous partners, including public service bodies (local authorities, hospitals, etc.), universities and research centers, associations, NGOs, international organizations, foundations, companies, universities, and schools

BECOMe responds to the urgency of the housing emergency affecting the Somali population after decades of unrest, that the research team proposed to approach through the construction of neighborhoods that can guarantee stability and durability. The project has promoted several declinations of how the commitment and social responsibility manifest within Politecnico di Milano:

Multidisciplinary research creates synergies to address complex issues of relevance to communities for human and socio-economic development in international socio-economic development.

Innovation, through the placement of research activities in problematic contexts, with the aim of developing methods and knowledge of more general applicability.

Dialogue with the outside world and the co-production of knowledge, through the creation of stable partnerships with institutions, companies, civil society, and international organizations, in which the role of the university is enhanced as an expert interlocutor and organizer of research activities on issues of direct interest to multiple communities.

BECOMe is therefore a bet and an act of faith by all the stakeholders—Somali and Italians—local institutions, construction workers, representatives of business activities, and academicians. The Somali National University, UN-Habitat, AICS Somalia, ANCE Lombardia, Holac Construction Company, and Architetti Senza Frontiere Italia made their expertise available in the spirit of co-production of knowledge for a local development plan to be shared with local stakeholder. The project has also contributed to strengthen the research team experience, which can be transferred to students—a future generation of professionals.

Despite the challenges that it encountered in the 2 years of work, the project was made possible thanks to both institutional and personal dedication.

Our gratitude goes to the principal investigator Prof. Oscar Eugenio Bellini, the project managers Prof. Claudio Del Pero, and Prof. Camillo Magni and all researchers, research fellows, Ph.D. candidates, and partners that embarked on challenging research that—we hope—will encourage further joint projects with Somalia.

Emanuela Colombo
Rector's Delegate for Cooperation and Development, Politecnico di Milano

Manuela Nebuloni
Polisocial

Introduction

The book deals with sustainable affordable housing in developing countries, providing the main results of the research BECOMe "Business ECOsystem design for sustainable settlements in Mogadishu: affordable housing, local entrepreneurship and social facilities", winner of the Polisocial Award 2018 competition, promoted by Politecnico di Milano.[1]

The topic of sustainable affordable housing in developing countries is becoming increasingly important for African and international stakeholders. At present, massive urbanization processes involve many countries, that are consuming large parts of territories and natural resources. These processes are developed far from any strategy of sustainability and social equality, without considering the long-term effects on the environment and on the next generations. Attention to the natural and human resources, the specific climate conditions, the preservation of the traditional culture, the improvement of social welfare, the development of enterprises, and expertise at the local scale are some of the hardest challenges that most of the

[1] This research "Business ECOsystem design for sustainable settlements in Mogadishu: affordable housing, local entrepreneurship and social facilities—BECOMe," was funded by "Polisocial Award 2018—City and Smart Community in Africa—Politecnico di Milano, fifth edition." It involved the following Departments: Architecture, Built Environment and Construction Engineering (DABC); Architecture and Urban Studies (DAStU); Management, Economics and Industrial Engineering (DIG). Scientific Coordinator: Oscar Eugenio Bellini. Project managers: Claudio Del Pero, Camillo Magni with Andrea Campioli, Davide Chiaroni, Stefano Guidarini, Cinzia Maria Luisa Talamo. Project team: Nazly Atta, Abdihakim Awaale, Anna Dalla Valle, Davide di Summa, Giuliana Maria Miglierina, Maricla Martire, Armin Mostafavi, Lucrezia Sgambaro. The research received the endorsement of the following subjects: ASF Italy (Architetti Senza Frontiere), no-profit design organization with an international network knowledge; Agenzia Italiana per la Cooperazione allo Sviluppo (Italian Agency for Development Cooperation) (AICS) Mogadishu (Somalia); ANCE Lombardia (Associazione Regionale dei Costruttori Edili Lombardi) Milan, (Italy), Regional association knowledge of the Italian Architecture, Engineering & Construction (AEC) sector/business; HOLAC Construction Company, Mogadishu, (Somalia)—Somalian construction company; UN-Habitat—United Nations Agency for Human Settlements and Sustainable Urban Development, Nairobi (Kenya).

African countries will face in the next years. In this perspective, the issue of affordable housing opens to many aspects that need specific approaches adapted to the many different African contexts.

Focusing on East Africa,[2] it is possible to assume the case of Somalia as representative of a fragile context characterized both by the uncertainty of the social, political, and economic situation and the lack of common shared legislative references and strategies. In this kind of contexts, the risk of developing inadequate construction practices is very high and the negative effects of unregulated urbanization are widespread and persistent. At the same time, the economic recovery and the high demand for affordable housing disclose the opportunity to create sustainable and durable settlements, going beyond basic shelters.

Starting from these premises, the book reports the main contents of the research whose aim is to provide knowledge, propose a methodological framework for the development of affordable and sustainable settlements and provide housing models and tools for the simulation of various scenarios. The long-term perspective is the development of sustainable settlements involving local entrepreneurship, boosting social facilities, and using renewable energies in order to stimulate the growth of a new housing market and attract national and international investors. The investigations and the proposals presented in the book are focused on the case of Mogadishu, but they are replicable in other high-risk environments, especially in East African countries.

On the basis of this main objective, the book deals with:

1. Knowledge, criteria, approaches, leverages, and barriers related to the development of strategies for the creation of new sustainable housing ecosystems, able to activate and boost local enterprises and to stimulate foreign investors for the revamping of the national AEC sector and the related manufacturing industries.
2. Models for modular settlements (considering typological, technical, economic, social, and environmental aspects), able to answer to the housing demand of low-medium-income population. The modular settlements integrate various types of flexible low-cost single/multi-family houses with adaptive spaces for craft, productive, and commercial activities for artisans/small local enterprises and social services.
3. Business models and assessment methodologies are useful to evaluate a set of appropriate technological solutions. These solutions are related to various types of construction process organization and some possible economic strategies, in the perspective to ensure a balance among the sustainability pillars (economic, environmental, social, and cultural).

The book is structured in three parts and nine chapters.

[2] East Africa (Eastern Africa or East of Africa) is a subregion of the African continent. According to the United Nations Statistic Division it consists in 18 countries and 2 dependencies. The subregion extends from Eritrea to Mozambique and borders the Indian Ocean. The Countries are Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe (Worldatlas, accessed in 2021).

Part I—East Africa Context

- Chapter "Ecosystem Perspective for Sustainable Settlements in East Africa", starting from some recent trends characterizing the social and economic context of the East Africa region, opens up some research questions related to the development of housing settlements assuming the ecosystem perspective and affordability and sustainability as strategic goals.
- Chapter "Housing in East Africa" analyses the housing issue in East Africa in its various forms. The chapter focuses on climate context and related climate responsive design and the new housing needs of the growing population.

Part II—Mogadishu as a Representative Case

- Chapter "The Dynamic and Fragile Context of Mogadishu as a Representative Case" provides an overview of the geographic, historical, political, and socio-economic dynamic and fragile application context of Mogadishu (considered as a representative case), highlighting its construction traditions and the main strengths, weaknesses, and open issues connected to a sustainable development. It investigates housing demand and defines levels of affordability.
- Chapter "Climate-Responsive Design and Energy Performance Goals" analyses the climate features of Mogadishu and provides the main rules for climate-responsive design and renewable energy integration.
- Chapter "The Fragmented and Heterogeneous Nature of Manufacturing and Construction Sectors in Mogadishu" sets up an investigation methodology appropriated for the specific context to describe the fragmented and heterogeneous nature of manufacturing and construction sectors in Mogadishu, underling main information gaps, current local practices, technical solutions, and organizational models.

Part III—Proposals for Sustainable and Affordable Housing in Mogadishu

- Chapter "Settlement Strategy Towards New Business Ecosystems" presents the concept of modular settlements for new business ecosystems, based on a set of incremental housing typologies to meet the high rate of low-medium-income population housing demand.
- Chapter "Construction Technologies and Materials for Sustainable Affordable Housing" proposes a methodology for assessing and selecting appropriate

building technologies for affordable housing, including a method for the systematic classification of building components, and investigates construction technologies and materials for sustainable affordable housing. It outlines possible perspectives of improvement towards industrialization of construction, use of local raw materials, and enhancement of construction quality through training.

- Chapter "Estimation of Construction Costs: From Technological Solutions to the Settlement Scale" introduces an estimation of construction costs to overcome inaccurate information, ranging from building to settlement scale.
- Chapter "Appropriate Tools for Decision-Makers: Proposal of a Decisional Support System (DSS)" develops a Decisional Support System (DSS) whose aim is to support decision-making processes towards affordable settlements in Mogadishu and the achievement of their long-term sustainability.

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About the Editors

Oscar Eugenio Bellini Architect, Associate Professor of Architectural Technology at the Department of Architecture, the Built Environment and Construction Engineering of Politecnico di Milano, where he works on research issues concerning building and construction design with a special interest in social and student housing, environmental design, and sustainability in architecture for new construction as well as renovation. He also conducts research in the area of housing and appropriate building technologies in developing countries. He is in research programs funded by Ministries and Public Bodies at different levels and in UE international projects. He is the author of books, essays, articles in reviews, and academic papers included in international conference proceedings, on topics related to sustainability in architecture and environmental comfort at building scale. He has overseen various projects for public and private buildings' new construction and refurbishment. He was the scientific coordinator of the research project Become.

Andrea Campioli Architect, Ph.D. in Architectural Technology, since 2005 full professor of Architectural Technology at the Politecnico di Milano, Department of Architecture, Built Environment and Construction Engineering (DABC). The research activity is focused on the effects of technic and technological innovations on design culture in architecture with particular attention to the innovation processes oriented towards environmental sustainability of buildings and components in the whole life cycle. He coordinates and participates in national and international research programs. He writes books and papers on reviews and attends international and national seminars and conferences about the topics of his research work. He's editor of the section Details of the review Costruire in Laterizio since 1991 and of the section Architecture of the review Costruzioni Metalliche since 1998.

Claudio Del Pero Engineer, Associate professor at the Politecnico di Milano University (Department of Architecture, Built Environment and Construction Engineering). He is actively involved in research and advisory activities related to energy efficiency in the building sector and to the exploitation of renewable energy sources, with particular reference to the topics of solar technologies and distributed energy generation.

Over the years he has been involved in various National and International research projects related to the exploitation of renewable energy sources, energy efficiency, and energy management at building and district levels. Since 2014, he has also participated in different research and cooperation activities on the above-mentioned topics in African Countries.

Cinzia M. L. Talamo Architect, Full professor of Architectural Technology at the ABC Department of Politecnico di Milano, she earned there a Ph.D. in Technical innovation ad design in architecture and a Master Degree (five years program) in Architecture, awarded with honours. She is President of the Sub Committee U/CTO25/SC03 Maintenance of Real Estate and Facility of UNI (Ente Italiano di Unificazione, the Italian institution dedicated to standardization). She is the Coordinator of the Scientific Committee of the ABC Department. Her main and long-term interest focus on planned maintenance, as well as building and urban facility management. A recent area of interest concerns cross-sector waste recycling in the perspective of industrial symbiosis and circular economy.

Davide Chiaroni Engineer, Full Professor of Strategy & Marketing at Politecnico di Milano, where he obtained cum laude his Master of Science in Management Engineering in 2002 and later in 2007 his Ph.D. in Management, Economics and Industrial Engineering. His research interest is in the management of innovation, with a particular focus on energy, sustainability, and smart ecosystems (grid, buildings, communities, cities). He is also among the most cited author in the field of Circular Economy, where he studies the implications of the adoption of circular business models. He is the co-founder of Energy & Strategy, a research group of the School of Management that publishes every year several research reports in the abovementioned fields that actively promote the debate in the industry and among policymakers.

Stefano Guidarini Architect. He worked in the Studios of the architects Giancarlo De Carlo (1982–86), Gino Pollini (1986), and BBPR-Belgiojoso (1987–90). Since 1990 he is practicing design research on public and private architecture, mostly related to the city and social housing. In 2011, he founded the post-graduate Master's Degree in Social Housing at the Politecnico di Milano. He is the Associate Professor at the Department of Architecture and Urban Studies of the Politecnico di Milano, where he teaches Architectural Design. He published the books Ignazio Gardella nell'architettura italiana (2002), Precisazioni sull'Housing Sociale in Italia (2017), New Urban Housing (2018). He won the 1996 In/Arch-Domus Architecture Prize and the Gold Medal for Italian Architecture of the Milan Triennale (2006). In 2010, he was invited to exhibit at the 12th International Architecture Exhibition of the Venice Biennale.

Camillo Magni teaches Architectural Design as Adjunct Professor at Politecnico of Milan and is Director of the Master "Design for development in the Global South." In 2004, he has been participating in the international research program "Casapartes" to build low-cost houses in Latin America. He is the author of more than 90 scientific

papers, 2 books, and co-the editor for Casabella. In 2007, he founded "Operastudio" a design office in Milan. In its first years, Operastudio has been focussing on both private and public sectors, soon achieving notoriety and awards in international competitions. Operastudio's work has been exhibited in the Lisbon Architectural Triennale, in the Milan Triennale, and in the Venice Biennale (2014). He leads the NGO Architetti senza frontiere Italia, working in several countries around the word and winning in 2015 the honourable medal of "Medaglia d'oro all'architettura italiana" and Silver medal "Fassa Bortolo" for the school project in Cambodia.

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