Jean-Claude Bolay · Silvia Hostettler
Eileen Hazboun *Editors*

Technologies for Sustainable Development

A Way to Reduce Poverty?

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Foreword

Science and technology are accepted as the driving forces of economic growth and social progress. Since the end of the twentieth century, they also constitute the most promising instruments to fight against two afflictions undermining the stability of our planet: the deterioration of environmental resources and the ensuing climate change; and the reduction of poverty, which today still affects close to 20 % of the world population.

World Bank statistics show that more than 1.4 billion individuals live on less than US$ 1.25 per day. This reality concerns all of us, and every one of us is moved, wherever we may be, with our knowledge, our expertise, and our desire to improve the living conditions on our planet, for the benefit of all.

Scientists, researchers, and teachers are not oblivious to this mobilization. For too long, they have been accused of living in an ivory tower. However, this does not take into account that numerous scientific inventions, technological innovations, and studies have allowed the implementation of products that promote sustainable development, and that have a positive impact, environmentally, as well as in social and economic terms—whether taking into consideration, for example, solar energy, already widely spread across the world and steadily improving, or telecommunications, that have led some authors to say that we now live in a "global village".

If such a conference has been convened at the Ecole Polytechnique Fédérale de Lausanne (EPFL), it is because we are collectively aware that the stakes in development are tremendous at the global level; inequalities persist and even tend to expand in certain regions of the world. As scientists and instructors of future engineers, we work at the earliest stages of achievements, which, one day, will change the lives of the World's citizens, but we also know that sometimes it will be many years before laboratory discoveries are applied in the field. It is therefore quite natural that we aim to strengthen relationships between researchers and decision-makers; between scientists and industrialists; between academics and beneficiaries; because it is from this dialogue that the best adapted solutions to social demands and recognized needs shall emerge. This dedication to excellence in education and research, to the internationalization of our collaborations and our projects, and to solidarity have long guided EPFL.

The 2012 EPFL UNESCO Chair International Conference on Technologies for Development reminds us that "planning and acting together" is a global objective. This concern will be pivotal to our discussions. Three key questions will steer the work of the conference:

- What is an appropriate technology? In aiming to better determine the real needs of the people in developing countries and in which way technology can address these needs;
- How to ensure an integrated sustainable development? In promoting interdisciplinary research and establishing partnerships that bring together various actors in development, public authorities, civil society, industry, and international organizations;
- What are the conditions for the co-creation and transfer of such technologies? By ensuring through appropriate methods and the exchange of knowledge, the sustainability of the innovations in the field and that their impact is beneficial to all.

Prof. Philippe Gillet
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Through openly sharing their considerable expertise and different outlooks, the keynote speakers at the UNESCO Conference contributed significantly to its success. Our heartfelt thanks go to Dr. Lidia Brito, Dr. Martin Dahinden, Dr. h.c. Pierre Landolt, Prof. Miguel Nicolelis, and Prof. Luc Soete for their highly appreciated involvement and support.

Likewise, this project could not have succeeded without the quality and diversity of the contributions of the various authors and researchers. In response to the call for papers, a Scientific Committee composed of experts from academic and non-academic institutions evaluated over 145 papers and ultimately selected 82 to be presented at the Conference. Of these, 20 were finally chosen for the originality of their approach to the publication's theme, "Technologies for Sustainable Development". We express our gratitude to all these authors, without whom this publication would not have been possible.

Our sincere thanks are extended to all our colleagues in CODEV at EPFL for their ideas, commitment, and for their encouragement.

We are very grateful for the generous patronage of the Swiss Agency for Development and Cooperation (SDC), the Canton de Vaud, the City of Lausanne, Landolt & Cie, Swiss Private Bankers, Cleantech Alps and the Commune of Saint-Sulpice, the conference sponsors. Their support and their partnership is critical to the achievement of our common mission which is to identify innovative solutions that are able to reduce poverty and lead the way toward more sustainable development at a global level.

Contents

Acronyms

ABPMDD	Agribusiness Promotion and Marketing Development Directorate
ACPP	Academic Cooperation Palestine Project
ACRA	Cooperazione Rurale in Africa and America Latina
AD	Anaerobic Digestion
ADB	Asian Development Bank
AEDE	Agence pour l'Energie Domestique et l'Environnement
AEPC	Alternative Energy Promotion Center
AFD	Agence Française de Développement
AG	Above Ground
ALNAP	Active Learning Network for Accountability and Performance in Humanitarian Action
ARIJ	Applied Research Institute Jerusalem
AT	Approriate Technology
ATT	Average Effect of Treatment on Treated
BCAS	Bangladesh Centre for Advanced Studies
BEE	Bureau of Energy Efficiency
BEEP	Building Energy Efficiency Programme
BHWDB	Bangladesh Haor and Wetland Development Board
BMU	Barrier Monitoring Unit
BoP	Bottom of the Pyramid
BSP-N	Biogas Sector Partnership Nepal
CBO	Community-Based Organizations
CBS	Central Bureau of Statistics
CCD Commission	Commission on Climate Change and Development
CCD	Climate Change and Development Division
CCT	Controlled Cooking Tests
CDE	Center for Development and Environment, University of Bern
CDMP	Comprehensive Disaster Management Programme of Bangladesh

CEA	Central Electricity Authority
CEAT	Communauté d'études pour l'aménagement du territoire (Urban and Regional Planning community)
CEGIS	Center for Environmental and Geographic Information Services
CFA	Central African CFA Franc
CFL	Compact Fluorescent Light
CFU	Colony Forming Unit
CH_4	Methane
CHF	Cooperative Housing Foundation
CIAD	Centre for Integrated Agricultural Development
CIDA	Canadian International Development Agency
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CODEV	Cooperation & Development Center
CPC	Compound Parabolic Collector
CRED	Centre for Research on the Epidemiology of Disasters
CRiSTAL	Community-Based Risk Screening Tool, Adaptation, and Livelihood
CTA	Centre des Technologies Appropriées de Maroua
DBPs	Disinfection By-products
DNA	Deoxyribonucleic Acid
DOM	Dissolved Organic Matter
DRR	Disaster Risk Reduction
DTI	Department of Trade and Industry
DTU	Development Technology Unit
E. coli	Escherichia coli
ECBC	Energy Conservation Building Code
EPFL	Ecole Polytechnique Fédérale de Lausanne
FAO	Food and Agriculture Organization of the United Nations
FAP	Flood Action Plan
GDP	Gross Domestic Product
GO	Governmental Organization
GO- > SPIN	Global Observatory of Science, Technology, and Innovation Policy Instruments
GPCC	Global Program for Climate Change
GTZ	German Agency for Technical Cooperation
H_2S	Hydrogen Sulfide
HA	Hectare
HDRO	Human Development Report Office
HFA	Hyogo Framework for Action
HP	Horse Power

HRT	Hydraulic Retention Time
HVAC	Heating Ventilation and Air Conditioning
hν	Light Irradiation
IAP	Indoor Air Pollution
ICIMOD	International Center for Integrated Mountain Development
ICOM	Steel Structures Laboratory
ICRC	International Committee of the Red Cross
ICS	Improved Cook Stove
ICSU	International Council for Science
ICT	Information and Communication Technology
IDE	International Development Enterprise
IEA	International Energy Agency
IETC	International Environmental Technology Centre
IFRC	International Federation of Red Cross and Red Crescent Societies
IGA	Income Generating Activities
IIED	International Institute for Environment and Development
iisd	International Institute for Sustainable Development
IMCI	Integrated Management of Childhood Illnesses
IOE	Institute of Engineering
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
IR	Islamic Relief
IRMA	Institute of Rural Management Anand
IRRI	International Rice Research Institute
ISRO	Indian Space Research Organization
IUCN	International Union for Conservation of Nature
KBM	Kernel-Based Matching
KFPE	Swiss Commission for Research Partnerships with Developing Countries
KIST	Kigali Institute of Science and Technology
KPT	Kitchen Performance Test
KSPB	Kerala State Planning Board
kW	kiloWatt
L	liter
LASIG	Research Laboratory for Geographic Information Systems
LCA	Life Cycle Assessment
LDC	Least Developed Countries
LEAF	Livelihoods, Empowerment, and Agroforestry
LED	Light Emitting Diodes
LFC	Large Fog Collector
LMCT	Ligand to Metal Charge Transfer
LPG	Liquefied Petroleum Gas

LPL	Lower Poverty Line
LULC	Land-Use/Land Cover
MACE	Malawi Agricultural Commodity Exchange
MAG	Mine Action Group
MDD	Marketing Development Division
MDG	Millennium Development Goals
MF	Membrane Filtration
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
Milli-Q water	Ultrapure water
MIS	Market Information Services
MK	Malawi Kwacha
MMM	Mahalanobis Metric Matching
MOF	Ministry of Finance
MOFDM	Ministry of Food and Disaster Management
MoP	Ministry of Planning
MPWH	Ministry of Public Works and Housing
NARC	Food Research Division, National Agriculture Research
NBKM	Cultural Network of New Belgrade" Association
NBTDP	North Bengal Terai Development Project
NCATSU	North Carolina Agricultural and Technical State University
NEA	Nepal Electricity Authority
NGO	Non-Governmental Organization
NH_4–N	Ammonium–Nitrogen
NIE	New Institutional Economics
NNM	Nearest Neighbor Matching
NOM	Natural Organic Matter
NP	Nepal
NPC	Nepal Planning Commission
NRC	National Research Council
NRC	Norwegian Refugee Council
NSERC	Natural Sciences and Engineering Research
O&M	Operation & Maintenance
OCHA-oPt	United Nations Office for the Coordination of Humanitarian Affairs in the occupied Palestinian territory
OECD	Organisation for Economic Co-operation and Development
OH	Hydroxyl Radicals
oPt	Occupied Palestinian territory
P	Phosphorus
PAPP	Programme of Assistance to the Palestinian People
PBF	Performance-Based Financing
PCA	Plate Count Agar
PCBS	Palestinian Central Bureau of Statistics

PCIA	Partnership for Clean Indoor Air
PET	Polyethylene Terephthalate
PH	Philippines
PLW	Physiological Loss in Weight
PNA	Palestinian National Authority
PPPP	Public Private People Participation
PVS	Participatory Variety Selection
Quv,n	Accumulated Energy
R&D	Research and Development
RCS	Rural Cold Storage
REC	Electronic Consultation Register (Registre Electronique de Consultation)
RM	Radius Matching
RMB	Renminbi, official currency of China
ROS	Reactive Oxygen Species
RW	Rwanda
S&T	Science & Technology
SDC	Swiss Agency for Development and Cooperation
SEI	Stockholm Environment Institute
SIDA	Swedish International Development Cooperation Agency
SIDS	Small Islands Developing States
SJTU	Shanghai Jiao Tong University
SL	Sustainable Livelihoods
SME	Small and Medium Enterprises
SNSF	Swiss National Science Foundation
SODIS	Solar Disinfection (Batch-process Solar Water Disinfection)
SRT	Solid Retention Time
SSA	Sub-Saharan Africa
SSF	Slow Sand Filtration
STI	Science Technology and Innovation
STIGAP	Science Technology and Innovation Global Assessment Programme
STS	Science and Technology Studies
TCE	Transaction Cost Economics
Tdh	Terre des hommes
THMs	Trihalomethanes
TS/TSS	Total Solids/Total Suspended Solids
UDMC	Union Disaster Management Committee
UG	Underground
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UNESCAP	UN Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNITWIN	University Twinning and Networking Programme
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
UP	Union Parishad
US DOD	United States Department of Defense
USAID	US Agency for International Development
USSR	Union of Soviet Socialist Republics
UV-A	Ultraviolet A
UV-B	Ultraviolet B
UV-C	Ultraviolet C
UXO	Unexploded Ordnance
VARG	Vulnerability and Adaptation Resource Group
VITA	Volunteers in Technical Assistance
VRC A	VRC Attendees (Coffee Planters)
VRC NA	VRC Non-Attendees (Coffee Planters)
VRC NANV	VRC Non-Attendees (Coffee Planters) from Neighbouring Villages
VRC	Village Resource Centre
VS	Volatile Solids
VSAT	Very Small Aperture Terminal
W	Watt
WASH	Water, Sanitation and Hygiene
WB	West Bank
WB	World Bank
WBT	Water Boiling Test
WHO	World Health Organization
WOCAT	World Overview of Conservation Approaches and Technologies
XAF	Central African CFA Franc

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Part I
Introduction

Chapter 1
Technologies and Partnerships

Silvia Hostettler and Jean-Claude Bolay

Abstract Appropriate technologies are technologies that are socially, culturally, environmentally and economically accepted by the stakeholders. It is necessary, therefore, to develop appropriate technologies in partnership with researchers, government agencies, and industry. It is essential that this be done in a process of co-creation with the beneficiaries. The development of appropriate technologies must also include the appropriate strategy to implement and maintain them. Innovative technologies have a central role to play in the effort to alleviate poverty in this world, which today is still overwhelming, with 20 % of the world population living on less than US$1.25 per day. The development of technologies that are adapted to unreliable energy systems, or the lack of transportation or communication infrastructure is indeed challenging. There are important constraints and requirements that need to be addressed for any technological development to succeed. However, it is encouraging to see that the development potential of appropriate technologies is much larger than the challenges, as shown in this publication's case studies from fields as diverse as agriculture, renewable energy, disaster risk reduction, ICTs and human settlements.

1.1 Introduction

One of the recurrent questions related to technologies for development is: "Are the technologies appropriate for the promoters? – Or for the users?" This debate needs to be placed in the current context that is structuring the contemporary world and can no longer merely be reduced to a simple North–South opposition. During the last 30 years, new economic powers have emerged, enjoying the benefits of

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globalization (liberalization of trade barriers and acceleration of communication technologies, among others) (England and Ward 2008), while having to face enormous challenges associated with climate change, urbanization, and poverty that economic growth has only partially managed to curb (Stiglitz 2007). Even though the number of the poor has globally decreased in percentage, social inequalities have increased. Moreover, it is the rural and urban poor who remain at the margin of progress, whether in social, health related or technological advancement. In thinking of their practical applications, technologies must be adapted to climatic, cultural and economic contexts (Bolay 2004), allowing beneficiaries – professionals, clients, and citizens – to master them, and therefore ensure optimal and sustainable utilization. If sustainable development aims to take fuller account of environmental factors, and implement technologies to reduce negative effects in this field, it also has to promote a more inclusive society and an economy that is not only focused on short-term profit.

However, many companies from the West, as well as from emerging countries, are looking for new markets while attempting simple technology transfers that will not be successful as long as the technology is not adapted to its users and local environment. For instance, according to the World Health Organization (WHO) "about 70 % of the more complex [medical] devices do not function when they reach their destination in developing countries". Among the main causes identified is the instability of the equipment to resist sudden changes in electrical current, because it succumbs to heat, dust or moisture, or simply because there is no one who knows how to use or maintain it (WHO 2010). Clearly, this type of technology is not adapted to the needs of many developing countries. As this is being recognized, a number of research teams, among them *EssentialTech*[1] at the Ecole Polytechnique Fédérale de Lausanne (EPFL), are developing medical equipment that inexpensive, robust, easy to use, and most importantly; developed in partnership with the beneficiaries and industry. Being affordable is already a step in the right direction; however, it does not mean technologies will be adopted if they do not respond to the needs of the beneficiaries. Chapter 7 on appropriate irrigation technologies in India, for instance, shows that low-cost is not always the determining factor in whether a farmer is willing to invest or not in a certain technology. Farmers preferred to pay for renting motorized irrigation pumps instead of opting for low-cost but labor-intensive traditional treadle pumps, as advocated by most non-governmental organizations (NGOs).

An appropriate technology has been defined as socially, culturally, environmentally and economically accepted by the stakeholders (Pearce et al. 2012; IETC 2003). For a technology to satisfy as many of these criteria as possible, it has o be developed in partnership with all stakeholders namely researchers, industry and civil society. The *EssentialTech* program goes even further by developing an entire value chain from the technical design to the deployment business model, including manufacturing, logistics, commissioning, usage, maintenance, waste and

[1] http://essentialtech.epfl.ch

recycling. This requires an interdisciplinary approach and partnerships with global and local players in the private sector and with public authorities and civil society. However, it is inevitable that a compromise will have to be made between the adaptation of a technology to a specific local context and the objective of large-scale deployment. This represents an important challenge because the perspective of a large-scale industrial production requires standard designs to keep costs down, while some level of adaptability to local specificities still needs to be maintained. Local capacity building is a key factor for successful deployment of technology, not only regarding the correct use of the technology and the maintenance, but also with regard to having the ability to identify the local needs of different groups of stakeholders that may have conflicting preferences. Furthermore, capacity building is often required to enable local stakeholders to develop a long-term vision based on sustainable development and the necessary commitment to pursue it. Therefore, it is imperative that the development of appropriate technologies also includes the appropriate strategy to implement and maintain them. Such an approach is essential to reach the ultimate objective of technologies for development, namely the reduction of poverty, which today is still overwhelming, with 20 % of the world population living on less than US$1.25 per day (World Bank 2011).

In this publication, the concept of partnership is discussed extensively. Successful partnerships are based on trust and communication and ultimately on a willingness to share power amongst stakeholders. The ideal manner in which to realize this has been analyzed in-depth by the Swiss Commission for Research Partnerships with Developing Countries (KFPE).[2] Guidelines were elaborated and formulated in 11 principles based on the belief that a fruitful partnership is "*a continuous process of sound knowledge generation, building mutual trust, mutual learning and shared ownership*" (KFPE 2012). Building a successful partnership begins by setting the agenda jointly, is carried forward by being accountable to beneficiaries and is completed by securing the outcomes. These are just three of the 11 principles on which partnerships should be built. Few partnerships will manage to implement all 11 principles faultlessly; however, all partnerships should make a serious attempt to do so. Interestingly, KFPE has also examined seven key questions regarding research partnerships, starting with the most obvious one: Why work in partnership? First, it can broaden perspectives and networks, provide institutional access and enrich the research process, many authors in this publication argue, however, that – more importantly – technologies in developing and emerging countries will most likely fail if they are not developed in partnership with stakeholders from the local context. For instance, as described in Chap. 6, the partnership between the International Committee of the Red Cross (ICRC) with local organizations, and in particular the clarification of the stakeholder's responsibility – another of the 11 KFPE principles – was crucial for the successful implementation of biogas sanitation systems in prisons in Nepal, Rwanda and the Philippines. After one year of operation, 11 of the 13 implemented systems

[2] http://www.kfpe.ch

were still functioning with excellent results in terms of technical performance, economic viability, environmental impacts and social acceptance. Other organizations, such as *access2innovations* based in Denmark, specialize in bringing together and administering networks to form partnerships around specific technological innovations for development. In Chap 13 David Christensen presents a case study from Vietnam in which a commercial venture was founded to address waste management issues based on innovative technology. This project was implemented in partnership with CARE International in Vietnam and Denmark, Danish companies and local authorities in Vietnam. These examples show that inter-cultural partnerships will inevitably lead to exchanges on underlying values, which effectively promote relevant research contributions in a development context. The systematic involvement of local communities and authorities accompanied by capacity building and knowledge sharing significantly multiply the chances of successful project implementation and ensuring long-term benefits. One of the main challenges remains the sharing of power and knowledge amongst the actors. This is crucial and at the same time quite difficult to achieve as, for instance, the management of intellectual property rights still poses major obstacles to equitable sharing of costs and benefits.

In an attempt to describe a process of technology development that is being done in partnership with the relevant stakeholders, the notion of co-creation is increasingly being used. Co-creation is considered to be more successful than technology transfer due to the fact that local users are involved from the conception, thereby steering the technology development in the direction most aimed at beneficiaries' needs and the local context. Interestingly, information and communication technology (ICT) itself is empowering a growing number of intended beneficiaries in developing countries to increasingly influence the development initiatives that are planned for them (Pearce et al. 2012; Thompson 2008).

Several papers in this publication illustrate the benefits of involving the beneficiaries throughout the process of technology development. For instance, in Chap 3, focusing on improving housing for the poor, Sytse de Maat argues that by involving the slum dwellers, better-adapted solutions can be identified instead of using industrially produced dwellings.

Industrially produced dwellings are typically used in slum rehabilitation programs with varying degrees of success. Sometimes the new type of dwelling drastically changes the lifestyle of the intended beneficiaries. There are cases where informal settlements are replaced by standardized mass housing with little participation by the inhabitants of the slums. The author maintains that an appropriate strategy consists in changing from a "user-participation" to a "user-driven" development thereby using the creativity of the users for developing the appropriate technology that does indeed respond to their needs. After all, they have managed to create informal settlements for themselves for decades. Chapter 14 by Marija Cvetinović also illustrates the potential of ICTs to empower civil society in Serbia. ICTs allow them to become actors in the transformation and creation of their cities via a virtual resource database. So, what can be done to support processes of co-creation? Which methods and instruments can be used? Chapter 11 by

Francesco Vitali on the development of improved cooking stoves in the Logone valley in Chad and Cameroon illustrates an approach that is based on the involvement of the beneficiaries at each step of the project. The aim of the project was to reduce wood consumption by improving the cooking technology and generating income. Initially, local cooking practices were examined and discussed with the local community in order to be able to meet their needs and priorities. Then, the technical performances of several stoves were tested; and finally, the *Centreafrican stove*, a model suggested by the local research center, was chosen, thereby ensuring long-term production systems and maintenance. This study also serves as a good example to illustrate how local knowledge can be included in research that is otherwise rarely well undertaken. Another excellent example is the work of Mahesh Neupane on developing rural cold storage systems in Nepal in Chap 9. In many rural areas of Nepal, electricity is unreliable or absent, therefore electricity-based storage systems like refrigerators for fresh farm produce are not an option. Mahesh developed a rural cold storage system (RCS), based on evaporative cooling and constructed with local materials such as bricks, sand, water, clay, straw, and bamboo, in close collaboration with the local farmers. The RCS can be constructed at a total cost of maximum US$120-$130 for a storage capacity of 200–300 kg of farm produce.

The concept of co-creation is used to describe a process where innovation is based on cooperation and mutual learning and takes into account not only the technological aspects but also the broader organizational, economic and social context. While the benefits of early involvement of local partner institutions and beneficiaries remains undisputed, there may be cases where an introduction of disruptive technologies meets with resistance from local population and politics; but this can potentially raise awareness about environmental issues and support policy changes. Chapter 23 on the introduction of fog collection technology developed by a Canadian NGO in Chile and Guatemala shows how a project that started with a technology transfer can evolve into a co-creation participatory process substantially increasing local organizational capacities.

New technologies can improve the lives of many people, but they can also worsen the situation for those not having access to them, or even create conflict regarding access and benefit sharing (Ferguson et al. 2010). For instance, if a minimal financial contribution by the beneficiaries is needed to access a technology, this might be impossible for those who are extremely poor. Therefore a new technology can potentially increase the divide between the poor and the very poor. Consequently, successful technology development and deployment is not enough. Thorough knowledge of the local context is also required to put measures into place that allow the adoption of the technology by all segments of the intended beneficiary population. This might involve providing training to those who do not know how to use or benefit from the technology.

In Chap 20 on research and innovation, Luc Soete highlights the importance of endogenous innovation processes that are replacing the traditional technology transfer or imitation models. In the new models, he argues that re-using and re-combining existing technologies with new knowledge will very often result in the

most appropriate technology because it has been developed by local users in local contexts where the technology will actually be used. Therefore he argues, the notion of "appropriate innovation" reflects this process better than "appropriate technology". Soete goes further by arguing that reverse transfer of technology – feedback from the Bottom of the Pyramid[3] (BoP) users in the South to designers and technology developers in the North – might arguably be one of the most exciting trends in technology development. Such processes might be the starting point for new alliances between local communities, NGO's and multinational firms to address the needs of BoP users at lower prices and adapted to unreliable energy systems, and the lack of transportation or communication infrastructure. Technology development in these conditions is challenging indeed; there are important constraints and requirements that need to be addressed for any technological development to succeed. However, innovative technologies have a central role to play in the effort to alleviate poverty in this world. The potentials are much larger than the challenges, as the case studies from fields as diverse as agriculture, renewable energy, disaster risk reduction, ICTs and human settlements, in this publication encouragingly show. Academia, civil society, local communities, governments, NGOs and industry need to increase collaboration and form effective partnerships in order to identify innovative solutions that are able to reduce poverty and lead the way towards more sustainable development at a global level.

This publication reflects on the outcome of the 2012 EPFL UNESCO Chair International Conference on Technologies for Development. It is structured into four sections of which the introduction is the first part. The papers in the second section focus on the question of appropriate technologies and in particular on the needs and participation of the various stakeholders. The third section investigates questions related to sustainable integrated development. Finally, the papers in the fourth section illustrate the need for empowerment, knowledge sharing and the role of innovation.

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[3] The term 'Bottom of the Pyramid' (BoP) suggests that multinational companies can make substantial profits by selling to the poor while at the same time help eradicate poverty (Prahalad 2006).