



Habitat Initiative Cabo Delgado, Mozambique

Press pack 05/2011

CONTENTS

- 3 PRESS RELEASE
- 4 FACTS
- 6 PROJECT DESCRIPTION
- 8 OVERVIEW OF PHOTOS
Cabo Delgado, on site investigation:
Village life and existing buildings
- 9 OVERVIEW OF PHOTOS
Building with earth
- 10 OVERVIEW OF PHOTOS
Building with bamboo
- 11 OVERVIEW OF PHOTOS
25 de Junho pilot project
- 12 OVERVIEW OF PHOTOS
Standard school type
- 13 OVERVIEW OF PHOTOS
Basic school type
- 14 OVERVIEW OF PHOTOS
Apprentice training programme
- 15 OVERVIEW OF PLANS
School types
- 15 OVERVIEW OF PLANS AND GRAPHICS
Analyse und details
- 17 PREVIOUS PUBLICATIONS
- 18 AGA KHAN DEVELOPMENT NETWORK (AKDN) PROFILE
- 19 COMPANY PROFILE
Ziegert | Roswag | Seiler Architekten Ingenieure
- 20 CONTACTS

PRESS RELEASE

Eleven Earth-and-Bamboo School Buildings Completed in Mozambique

The Aga Khan Foundation in Mozambique has completed construction on eleven village school buildings in the country's poor Northern region. The schools were built using natural resources, and were built as pilot projects for an improved, more permanent construction style that incorporates and develops both local craft skills and locally-available building materials.

Residents of the region live in simple earthen huts which become uninhabitable and collapse after just five to eight years. They dream of owning more permanent, modern brick and concrete houses, even though they know the humidity-regulating earthen homes are cooler and more comfortable inside. Homes built using modern materials heat up rapidly in summer, are highly prone to mildew, and are generally uncomfortable and unhealthy.

Village communities build and run preschools entirely on their own, as there is no government assistance for early childhood education. The Aga Khan Foundation continues to support the communities in both construction of preschool buildings and teacher training.

The model buildings for the improved construction method were completed as part of the Foundation's Habitat Initiative Cabo Delgado project; these eleven village preschools are designed to be used as adult-education and community centres as well. Among the project's design innovations is the use of the thin (3.5 - 5 cm) bamboo found in the region to develop a roof truss capable of spanning a six metre-long room without supports. The trusses are formed using a simple dowelled connector and tied together. Seven larger schools were built using this method, while four smaller ones spanning 4 metres apiece were completed using a process very much like the one used for area homes. These simplified buildings are designed to showcase improvements to the traditional building process and to serve as models for future housing construction.

The project also included a training programme for 40 local craftsmen, who now have the skills necessary to start their own firms so that they may later realise projects on their own.

In order to promote more widespread use of the new system, the Aga Khan Foundation plans to use it in several of its upcoming construction projects. Planning is currently underway for the construction of six granaries, and other buildings may follow.

FACTS

Habitat Initiative Cabo Delgado, Mozambique

- new construction of 11 preschools and community centres in villages in Cabo Delgado, a poor region in northern Mozambique
- use of local construction materials: earth, bamboo and palm leaves
- buildings made more permanent thanks to moisture-resistant foundations, damp-proof courses, protection against termites and improved natural palm-leaf roofing
- incorporation of 3.5 cm-thick bamboo roof trusses into the new building method, allowing for the construction of rooms spanning up to 6 metres
- project realisation together with local craftsmen, who were schooled in the new construction techniques
- updates to existing local building traditions; reinforced identification with regional culture
- creation of new local sources of income
- construction of 7 schools with room spans of 6 metres
- construction of 4 schools using a simplified method similar to the one used for local houses

Project Team

Project Initiators and Organisers

Aga Khan Foundation (AKF) Mozambique:

Faiza Janmohamed, CEO Maputo

Joanna Grace, director of programme, Pemba

Marcelino Pedro, project manager, infrastructure coordinator, Pemba

Architects

Roswag Architekten

Eike Roswag, Dipl.-Ing. Architekt BDA, Project Manager, Conceptual Design

Dipl.-Ing. Arne Tönißen, Associate Project Manager, Drafts, Construction Supervision

Alexandra Sohn, Trainee, Planning

Eva Holtz, Trainee, Planning, Manual

Nicolas Hißnauer, Trainee, Construction Supervision

Joao Guimares, Construction Supervision and Documentation

Dipl.-Ing. Hendrik Schultz, Planning and Documentation

Amaya Barrera Gonzales, Construction Supervision

Structural Design, Technical Consultation on Earthen Building

Ziegert | Seiler Ingenieure

Dr.-Ing. Christof Ziegert, Specialist Consultant on Earthen Construction Methods

Dipl.-Ing. Uwe Seiler, Structural Frame Design

Dipl.-Ing. Lars Fechner, Structural Frame Design

Advisory Work on Bamboo Construction, Joining Techniques

Geflecht und Raum, Emmanuel Heringer

Graphic Design

Christiane Liebert, Dipl. Designerin (FH)

Implementation

Forty local craftsmen and assistants from the villages, who received further training as part of the project; additional support provided by the Aga Khan Foundation Mozambique

Planning and Construction Timeline

Research Workshop: June 2008

Web-Based Drafting Workshop: July 2008

Prototype Workshop; Start of Pilot Project: August 2008

Completion of 11 Schools: December 2010

Realised Projects

Schools in Pemba Metuge

Pilot Project

One school in 25 de Junho

50 square-metre classroom

100 square metres of additional covered space, including separate building for ecological latrines

Total area: 150 square metres

Standard School Type

6 schools in Impiri, Nacaramo, Nacopo, Unidade, Nacuta, Pulo

50 square-metre classroom

60 square metres of additional covered space

Total area: 110 square metres

Simplified Schools in Macomia

Basic School Type

4 schools in Machova, Koko, Bangala, Ntapuala

40 square metres of classroom space, divided into 2 classrooms measuring 5 x 4 m

32 square-metre veranda designed for use as a roofed outdoor area

Total covered area: 72 square metres

Total area of all 11 schools: 1098 square metres

PROJECT DESCRIPTION

Original Situation: Local Residents' Poor Housing Conditions

Mozambique's poor Northern region is predominantly populated by villagers living in simple mud huts. These houses have a lifespan of only five to eight years, due to the shortcomings of the construction method and the lack of materials necessary to make the houses more durable. The main problems with the huts are that their foundations are not solid enough and that the traditional design lacks a horizontal barrier against rising damp. Moisture thus rises unhindered into the earthen walls and then evaporates around the plinth, leaving behind salts which damage the walls at the base. The wood and bamboo used to construct the walls and roof are not protected against insects or harmful plants, and are thus very quickly attacked and destroyed by termites or other parasites. The roofs are often finished using nothing more than bundles of steppe grass which has not been crafted into a more watertight roof covering. Oftentimes, construction on the houses is left incomplete, and the roofs begin to leak after just three years. In addition, very few houses have a proper floor. Residents are therefore obliged to build new houses every five to eight years - the amount of time it takes the old building to become uninhabitable and collapse. Thus, inhabitants of the region spend great portions of their lives in very poor housing.

When used in construction, earth absorbs humidity and then releases it again, which provides natural indoor climate control and cools the rooms during the hot summer months. Even though residents are aware that earthen buildings provide more comfortable indoor environments, they still find more permanent brick or concrete-block houses more desirable.

In this rural region, however, hardly anyone can afford these costly and energy-intensive materials, so most people still live in harmony with nature. Construction materials are obtained from nature, and then return to nature after the house's lifespan has ended. One problematic practice is the frequent use of wood and, in the coastal areas, of mangrove trunks. The region has no sustainable forestry-management programme, meaning that the formerly well-forested Mozambique has suffered from deforestation for many years, thus contributing to global warming and losing its natural resources.

Objectives of the Aga Khan Foundation

Habitat Initiative Cabo Delgado was founded for the purpose of creating more permanent housing solutions using local, natural building materials. Local construction methods were developed and improved upon in ways tailored to local craftsmen's abilities; thus supporting the local "construction culture" and reinforcing village identity. The Aga Khan Foundation continues to support Cabo Delgado villages in the construction and operation of preschools, for which village communities receive no government assistance. Prototypes for the new building method have been erected around the region, in the form of eleven preschool buildings which can also be used as community and adult-education centres.

One Construction System – Eleven Schools, Two Building Types

In order to combat deforestation, the construction system is designed to use as little wood as possible. Instead, the buildings are constructed using the earth-block method, which can also be found in the region. Roof constructions, doors, windows and other details are built of bamboo. Borax, a natural salt, is used to protect the materials against parasites. The **foundations** are made of rammed earth **stabilised with 10% cement**; stabilised earthen blocks are used above ground. Natural stone is used in the regions where it can be found. A PE-foil **horizontal damp-proof course** is laid on top of the foundation as protection against moisture rising from the subsoil. The walls are constructed using non-stabilised earthen blocks, which are formed by hand and then dried in the sun. Oil- or coconut-palm leaves are used to make roof coverings. These changes to the construction method have resulted in durable buildings which, if properly maintained, face no limitations on their lifespans.

The **Standard Type** was developed in 25 de Junho as a prototype, and then built in six additional locations following some minor changes. To make the buildings equally suitable for use as normal schools and/or community activity centres, and to highlight the potential inherent in local materials, a beam **spanning 6 metres** was developed using the thin (3.5 to 5 cm – diameter) bamboo found in the region. Local craftsmen can create these beams over a simple dowelled joint or truss using ordinary hand tools. Besides the 6 x 9 metre classrooms, the buildings also have so-called open-air classrooms measuring 25 square metres, as well as the verandas typical for houses in the region. The indoor classroom provides the peace and quiet necessary for undisturbed learning, while the covered outdoor area serves as a well-ventilated area for everyday activities.

A **Simplified Building Type** drawing more heavily upon the construction methods used in local houses was also developed in order to provide smaller villages and user groups with a model for future permanent constructions. For these buildings, the foundation and damp-proof course are laid as described above, after which earthen bricks measuring 24 x 24 x 12 cm – **like those found in local housing traditions** – are laid in an upright position to form the masonry. The roof is constructed using individual stalks of bamboo rather than bamboo beams. Instead of interior walls, the simplified design uses a bamboo truss and a column near the back of the classroom. This method permits the construction of classrooms measuring 4 x 5 metres, which provide sufficient space for small groups.

Bamboo is also used for the doors and windows. The interior walls are finished with earthen plaster and painted with lime. Floors are made of either rammed earth or, where available, natural stone.

The system could be used to construct houses in the future. Building a **permanent** home costs between **80 and 100 euros**, which is equivalent to around two or three months' wages for a local day labourer. Financing such a project should be no problem with the help of a microloan.

Local Craftsmanship and Income

As part of the building process, 40 local craftsmen underwent training in the new construction techniques; these craftsmen are now in a position to help knowledge of these new methods spread around the region. A manual describing every aspect of the new method in detail – including physical properties of the different building materials, preparing materials for use in construction, each step of the construction process and building maintenance procedures – was developed and introduced for use as a training manual and a simple reference guide.

The Aga Khan Foundation now intends to apply the system to the construction of barns spanning 6 metres; this will create income for village residents by enabling them to do construction work without needing either workmen or materials from the cities. The craftsmen are currently starting their own companies so that they can take over full responsibility for new construction projects in the future.

Other projects for the future include developing improved methods for cultivating bamboo and introducing these into regional agriculture. Farmers could also learn to apply the protective salts to the bamboo and then sell ready-to-use materials. Another plan is to set up permanent workshops where good-quality construction elements such as beams, doors and windows could be efficiently premade, after which the finished products could be transported to construction sites.

OVERVIEW OF PHOTOS

Cabo Delgado, on site investigation: Village life and existing buildings



A01 Village life in the Pemba Metuge region (Photo: Roswag Architekten)



A02 Traditional hut constructed of wood, bamboo and earth using wattle-and-daub technique; grass roof (Photo: Paula Holtz)



A03 Daily life on the verandas around the houses (Photo: Paula Holtz)



A04 The average lifespan of a traditional house is around five to eight years. Rising damp, termites and leaking roofs all gradually destroy the structures (Photo: Roswag Architekten)



A05 Government-constructed school made of concrete, steel and tin (Photo: Paula Holtz)

OVERVIEW OF PHOTOS

Building with earth



B01 Collecting and mixing earth
(Photo: Roswag Architekten)



B02 Earthen block production
(Photo: Paula Holtz)



B03 Natural stones used where available to build foundations; cement-stabilised earthen blocks used in other areas (Photo: Roswag Architekten)



B04 Cement-stabilised earthen block foundation; horizontal damp-proof course; earthen blocks
(Photo: Roswag Architekten)



B05 Earthen blocks used in standard school construction type to build 25 cm-thick masonry walls
(Photo: Paula Holtz)



B06 Masonry in simplified school constructions and private homes built by laying traditionally-sized (24 x 24 x 12 cm) earthen blocks upright vertically
(Photo: Paula Holtz)

OVERVIEW OF PHOTOS

Building with bamboo



B07 Bamboo laid horizontally for treatment with Borax salt (Photo: Roswag Architekten)



B08 Bamboo set vertically for treatment with Borax solution (Photo: Roswag Architekten)



B09 Joints formed on triple-layer bamboo beams using bamboo rods and wire (Photo: Roswag Architekten)



B10 Bamboo workshop: production of triple-layer beams (Photo: Roswag Architekten)



B11 Bamboo workshop: bamboo used to build load-bearing trusses used in roof construction (Photo: Paula Holtz)



B12 Transportation of the bamboo trusses from the workshop to the site (Photo: Roswag Architekten)



B13 Mounting the roof construction on site (Photo: Paula Holtz)



B14 Mounting roof battens (Photo: Paula Holtz)



B15 Laying palm-leaf roof thatch (Photo: Paula Holtz)



B16 Close-up view of bamboo truss and palm thatch (Photo: Paula Holtz)



B17 Door lock made of bamboo (Photo: Paula Holtz)



B18 Mounting bamboo doors (Photo: Paula Holtz)

OVERVIEW OF PHOTOS

25 de Junho pilot project



B19 25 de Junho pilot project / South-east view (Photo: Paula Holtz)



B20 25 de Junho pilot project / West view (Photo: Paula Holtz)



B21 25 de Junho pilot project / South view (Photo: Paula Holtz)



B22 25 de Junho pilot project / View of classroom entrance from outside (Photo: Roswag Architekten)



B23 25 de Junho pilot project / Lessons in the classroom (Photo: Paula Holtz)



B24 25 de Junho pilot project / Classroom (Photo: Paula Holtz)



B25 25 de Junho pilot project / Bamboo roof construction (Photo: Paula Holtz)



B26 25 de Junho pilot project / Benches and interior fixtures (Photo: Paula Holtz)

OVERVIEW OF PHOTOS

Standard school type



B27 Standard school type in Unidade / West view (Photo: Paula Holtz)



B28 Standard school type in Nacopo / Southwest view (Photo: Paula Holtz)



B29 Standard school type in Nacuta / West view (Photo: Paula Holtz)



B30 Standard school type in Nacuta / South view (Photo: Paula Holtz)



B31 Standard school type in Nacuta / Veranda (Photo: Paula Holtz)



B32 Standard school type in Impiri / Classroom (Photo: Paula Holtz)



B33 Standard school type in Nacaramo / View of roof construction (Photo: Paula Holtz)



B34 Standard school type in Unidade / Interior view of school (Photo: Paula Holtz)

OVERVIEW OF PHOTOS

Basic school type



B35 Basic school type in Bangala / South view (Photo: Paula Holtz)



B36 Basic school type in Koko / North view (Photo: Paula Holtz)



B37 Basic school type in Machova / Northwest view (Photo: Paula Holtz)



B38 Basic school type in Bangala / Closeup view (Photo: Paula Holtz)



B39 Basic school type in Machova / Classroom (Photo: Roswag Architekten)



B40 Basic school type in Ntapuala / Windows (Photo: Paula Holtz)



B41 Basic school type in Koko / Door and windows (Photo: Paula Holtz)



B42 Basic school type in Ntapuala / Roof construction (Photo: Paula Holtz)

PHOTO GALLERY

Apprentice training programme



B43 Training apprentices
(Photo: Paula Holtz)



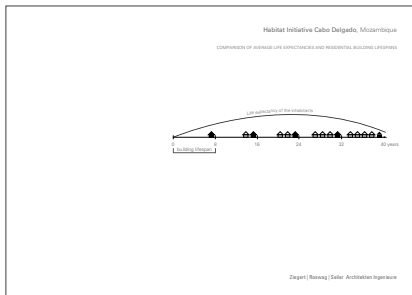
B44 Training apprentices using the
building manual (Photo: Paula Holtz)

OVERVIEW OF PLANS AND GRAPHICS

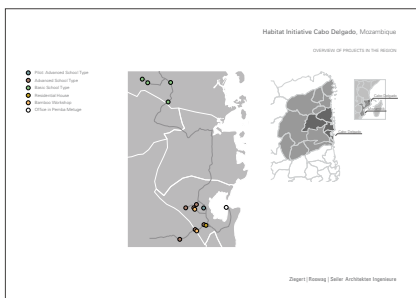
Analyse und details



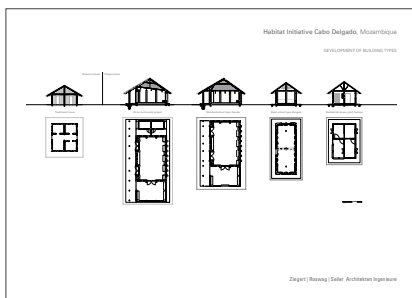
01 Settlement layout



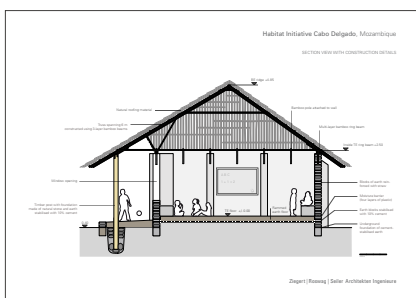
02 Comparison of average life expectancies and residential building lifespans



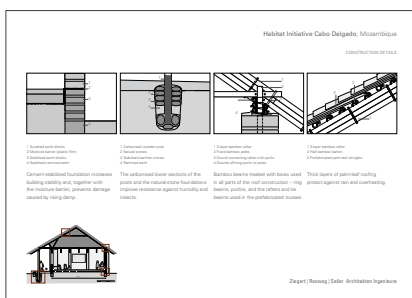
03 Overview of projects in the region



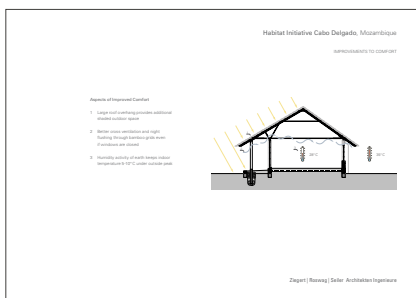
04 Development of building types



05 Section view with construction details



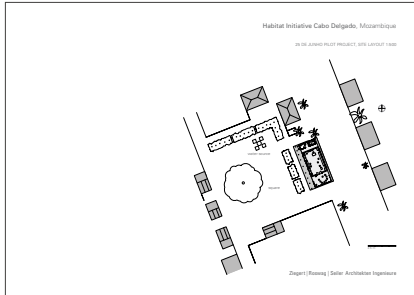
06 Construction details



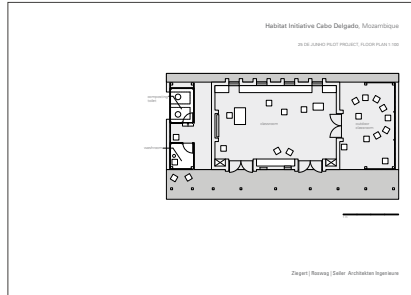
07 Improvements to comfort

OVERVIEW OF PLANS

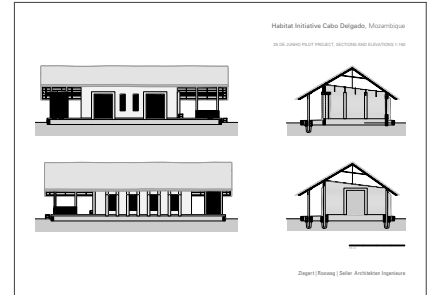
School types



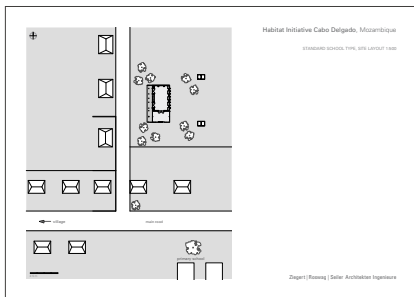
08 25 de Junho pilot project /
Site layout 1:500



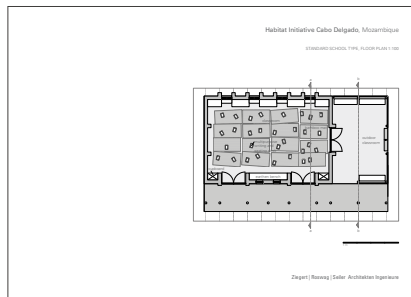
09 25 de Junho pilot project /
Floor plan 1:100



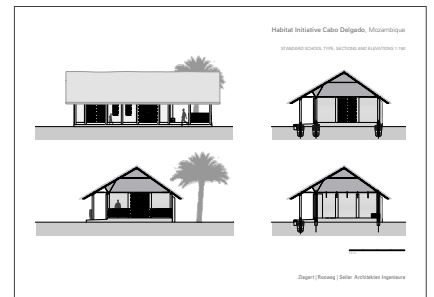
10 25 de Junho pilot project / Sections
and elevations 1:150



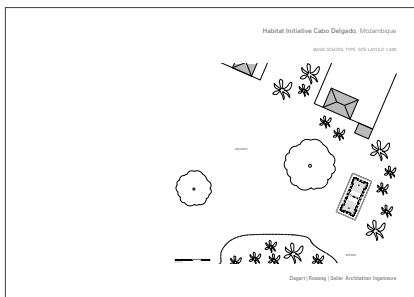
11 Standard school type /
Site layout 1:500



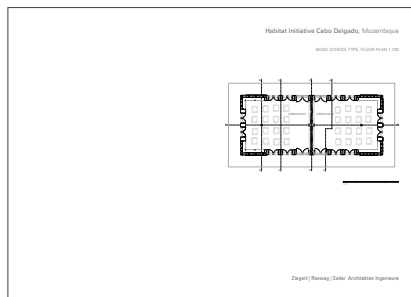
12 Standard school type /
Floor plan 1:100



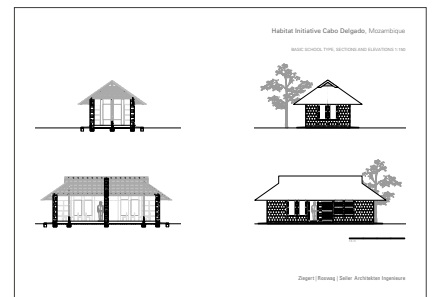
13 Standard school type / Sections
and elevations 1:150



14 Basic school type / Site layout 1:400



15 Basic school type /
Floor plan 1:100



16 Basic school type / Sections
and elevations 1:150

PREVIOUS PUBLICATIONS

- Participants in the “Measure of Man - Measure of Architecture” exhibition,
AEDES Berlin August 12th to November 10th, 2010
German Gymnasium, London January 2011
- Film: “Earth Works” by AKDN. More information on the project available online under:
www.architekturclips.de/earth_works

AGA KHAN DEVELOPMENT NETWORK (AKDN) PROFILE

About the Aga Khan Development Network

The Aga Khan Development Network (AKDN) focuses on health, education, culture, rural development, institution-building and the promotion of economic development. It is dedicated to improving living conditions and opportunities for the poor, without regard to their faith, origin or gender.

Organisational Information

The AKDN works in over 30 countries around the world. It employs approximately 80,000 people, the majority of whom are based in developing countries. The AKDN's annual budget for non-profit development activities in 2010 was approximately US\$ 625 million. The project companies of the Aga Khan Fund for Economic Development generated revenues of US\$ 2.3 billion in 2010 (all surpluses are reinvested in further development activities).

AKDN's Approach to Development

Founded and guided by His Highness the Aga Khan, the Aga Khan Development Network (AKDN) brings together a number of development agencies, institutions, and programmes that work primarily in the poorest parts of Asia and Africa. While each institution pursues its own mandate, all work together within the overarching framework of the Network so that their different pursuits interact and reinforce one another.

About His Highness the Aga Khan, Chairman of the Aga Khan Development Network

His Highness the Aga Khan, the founder and chairman of the AKDN, is the 49th hereditary Imam (Spiritual Leader) of the Shia Ismaili Muslims. In Islam's ethical tradition, religious leaders not only interpret the faith but also have a responsibility to help improve the quality of life in their community and in the societies amongst which they live. For His Highness the Aga Khan, this has meant a deep engagement with development for over 50 years through the agencies of the AKDN.

Aga Khan Foundation Mozambique

AKDN's activities in Mozambique are concentrated in Cabo Delgado, the northernmost, and poorest, province of Mozambique. The Aga Khan Foundation (AKF) supports three programmes in the province: the Coastal Rural Support Programme (CRSP(M)), the Entrepreneur Development Initiative (EDI), and the Bridges to the Future (B2F) programme.

CRSP(M) was initiated in 2001 as an integrated programme of activities in health, education and rural development. It is working in five districts of Cabo Delgado province (Quissanga, Ibo, Meluco, Pemba Metuge, and Macomia) with the aim of increasing food security and income generation opportunities, as well as health and education, for rural households, particularly women.

Bridges to the Future (B2F) works to strengthen the human resources of the province. In 2006, it provides scholarships and facilitates internships. English language courses and management training are also being delivered.

Raising Rural Incomes While Revitalising Local Culture

The vast majority of AKF beneficiaries are small producers whose livelihoods depend on income from selling their crops or the products they make. Their incomes are strongly affected by factors such as the level of technical knowledge, physical distance to markets, uneven competition due to national and international trade policies, devastation of war and limits on productivity caused by environmental degradation.

COMPANY PROFILE: ZIEGERT | ROSWAG | SEILER ARCHITEKTEN INGENIEURE

Ziegert | Roswag | Seiler Architekten Ingenieure was founded in 2003 and has its headquarters in Berlin. Our two design companies, Roswag Architekten and Ziegert | Seiler Ingenieure, unite a broad spectrum of services under one roof: architecture, structural engineering, energy planning and consulting services, building assessment and certification, materials testing and development, and scientific research and educational work.

Our core competency is the use of natural materials, especially earth, in construction. Our projects range from a timber firehouse in Brandenburg, a white earthen home in Berlin's Westend and a bamboo-and-earth school in Bangladesh to historical monuments in the Arabian Peninsula and school projects in Africa.

We pride ourselves on our continued success in creating comfortable and energy-efficient buildings together with our highly-qualified partners. Natural construction materials address a worldwide growing awareness of the need for healthy, environmentally-sound architecture; they are energy- and cost-efficient as well as fully recyclable. When used in construction, earth absorbs pollution, regulates air humidity and provides superior climate control. Our low-energy houses, which are made of natural building materials and earth, do not require additional mechanical ventilation, meaning they reduce operational costs without sacrificing comfort.

We are trained energy consultants for both residential and non-residential buildings, and we have KfW certification as on-site consultants. As accredited DGNB (German Society for Sustainable Architecture) auditors as well as accredited LEED (Green Building Rating System) professionals, we provide consultation and building certification under both systems.

Integrated planning and realisation of complex projects is a hallmark of our work. Our projects are built upon a foundation of positive communication and culturally-sensitive interaction with project partners from a variety of cultures throughout our international network, and we strive to reinforce existing traditions through our use of local solutions. Our young team is currently made up of 25 architects and engineers in Germany and abroad. Our work has garnered us a number of competition prizes and awards, including the Aga Khan Award for Architecture, and has been profiled in a number of publications.

We served as managing directors of the Habitat Initiative Cabo Delgado, Mozambique on a volunteer basis, and provided trainees for additional support. Our colleague Arne Tönißen spent a little over two years on-site doing project realisation work for the Aga Khan Foundation Mozambique. Developmental cooperation projects are very important to our entire team, and motivate us to make other people the centre of our work.

CONTACTS

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