Affordable building materials from recycled agricultural waste, Zaria, Nigeria

„to which degree does the project contribute to the innovation of building materials and construction technologies in the context of sustainable construction“ ?

project goals

Our project goal of creating a catalyst with which to address the subject of sustainable construction in the context of Nigeria, can only be effective if combined with specific socio-cultural issues pertinent to many developing economies.

These issues include:
_agricultural/waste recycling (economy)
_sustainable resource management (research/engineering)
_provision of affordable shelter (architecture)

These core themes are grouped under 3 categories: economy, engineering and architecture
The detailed goals will be explained as follows.

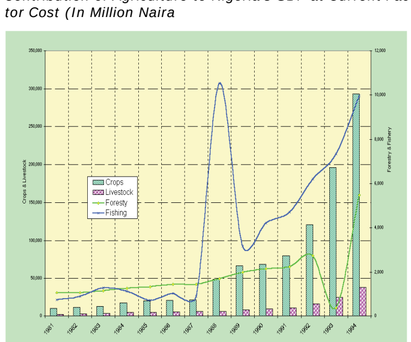
1) sustainable construction and economy
_Empowering farmers
_fostering entrepreneurship
_economic sustainability

2) sustainable construction and engineering research
Leverage effects interdisciplinarity
_empowerment through education
_innovative production

3) sustainable construction and architecture
_ local materials, local practises, local architecture

1) sustainable construction and economy

farming as resource:
Contribution of Agriculture to Nigeria's GDP at Current Factor Cost (In Million Naira



_empowering farmers:
we make it possible for local farmers to earn from the sale of „waste materials“ to local producers.

_fostering entrepreneurship:
we raise the economic interest in agricultural waste recycling and encourage entrepreneurship.

_valoration of farming as an important resource

Truly sustainable development is only meaningful, if coupled with a parallel improvement in local economic opportunities, as well as environmental protection.

In terms of employment, agriculture is by far the most important sector of Nigeria‘s economy, engaging about 70% of the labor force.

Relatively small farms produce about 80% of the total food supply. About 30.7 million hectares, or 33% of Nigeria‘s land area, are under cultivation.

Coupled with this advantage, Nigeria‘s diverse climate, from the tropical areas of the coast to the arid zone of the north, make it possible to produce virtually all agricultural products that can be grown in the tropical and semitropical areas of the world.

This is of enormous advantage for a construction industry that could benefit from agricultural waste products.

_empowering farmers

At a local level, should the abundant plant based agricultural waste from land cultivation no longer be incinerated at great disadvantage to the environment, recycling them could help in reducing poverty by offering an added income-earning opportunity to local farmers who can now sell their hitherto „waste materials“ to local producers.

_fostering entrepreneurship

As the economic interest in recycling is raised, the gathering of these materials on a larger scale has the potential to further strengthen local economies, promote economic modernisation and diversification and help reduce poverty by offering an extensive labour market for the collection, and a higher income earning opportunity for entrepreneurs who are interested in establishing a network for the distribution of these agricultural waste materials.

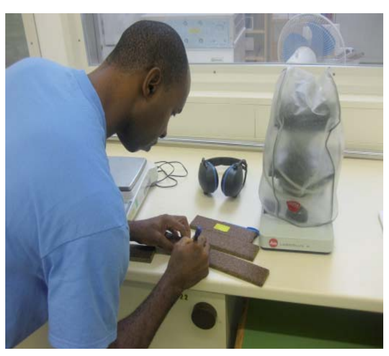
_economic sustainability

More importantly, the utilisation of these local materials should reduce the need to rely on more expensive, imported, non sustainable building materials.
Gathering and processing local materials, by virtue of their familiarity and availablity, encourages a greater involvement of the local population in the manufacturing and distribution process.
It further strengthens local economies and fosters sustainable growth.

2) sustainable construction and engineering research

leverage effects_ interdisciplinarity
we bring together architects, material & agricultural engineers

_empowerment through research education
we disseminate research expertise and methodology.



_innovative production
we successfully used Tannine as an alternative to synthetic adhesives

leverage effects interdisciplinarity

By researching and producing composite building materials from vegetable waste using low technology, we bring together material and agricultural engineers and architects, and propagate an integrated method of crop cultivation and crop waste management.

Working with our partner institutions, we promote a multi-disciplnary approach to problem solving that ensures a transfer of knowledge across various disciplines in an investigative framework.

_empowerment through research education

Our project is application oriented development that is aimed not only at disseminating research methodology. We aim to achieve a sustainable intercultural cooperation through educational training and knowledge exchange between the institutions.
We are in the process of establishing a production workshop in the partner institution, where the acquired knowledge and practical experience tempered with locally defined performance parameters, will be deployed in producing building material specifically tailored for the Nigerian context.

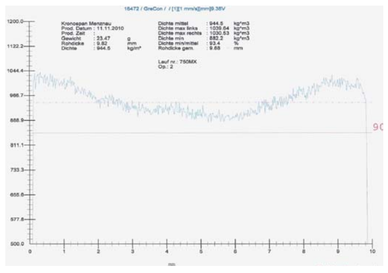
_innovative production

Faced with acute shortages of fossil fuel resources along with rising prices, the interest in natural adhesives for bonding particle boards has recently been on the increase.
Our research successfully deployed Tannine as an alternative to synthetic adhesives for the production of the composite panels. Extracted from wood and bark, Tannin-hexamine adhesive is free of Formaldehyde, and consequently a sustainable alternative Adhesive for particleboard

3) sustainable construction and architecture

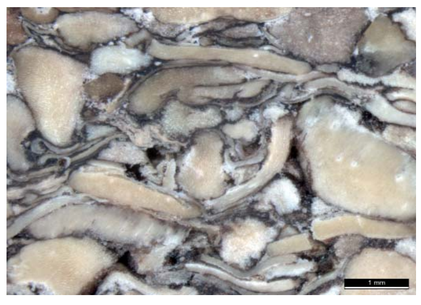
local materials for local architecture

typical density profile of corn cob panels

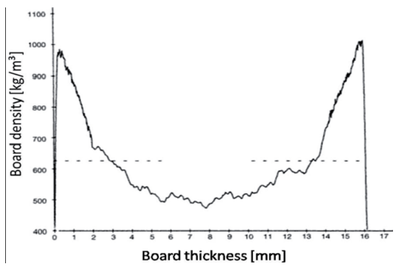


creative hub to be set up at partner institution

microscopic section of corn cob panel



typical density profile of wood based panels



_local materials

Our research investigated the applicability of corn cobs, rice husks and groundnut shells as raw materials for composite panels to be produced and used in Nigeria.

Single layer composite panels based on these materials were produced at laboratory scale, using different parameter sets for density, resin load, press temperature, moisture content and particle size. To avoid formaldehyde emission, tannin hexamine formulation was chosen.

The panels were tested according to EN standards for wood based panels. The mechanical properties of particleboards derived from rice husks and groundnut shells failed to satisfy the standard requirements. These materials may potentially be used as thermal insulation and decorative cladding material.

Panels made of corn cob achieve the standard specifications in terms of strength properties, but at higher density compared to common wood based particleboard (see graphs).

_local practises

We are now in the process of establishing a physical workshop in the partner university. We have raised enough funding to acquire rudimentary production machinery to shred and press the boards. This workshop is envisaged as a creative „hub“ where further research will be propagated. The hub is an ideal training opportunity, where local craftsmen can be involved in working with the new materials.

We are negotiating with a local producer who is interested in the commercialisation of our particle boards for the Nigerian and West African market.

_local architecture

Our ultimate goal is to erect prototype case-study units using the new composite materials that are informed by local customs to meet local comfort and aesthetic demands. As a consequence, the design and construction of the low cost housing proposals will be done in close collaboration with:

_ the future users of the buildings who will be able to shape them according to their needs
_ the local craftsmen to introduce valuable skills and transmit acquired knowledge.

The pilot project will deliver valuable information with regard to technical details, durability, comfort, indoor environment, etc. Future users will have the opportunity to influence the pilot project thus guaranteeing its future acceptance.