
Linking carbon offsetting mechanisms to financial incentives for eco-construction in the Sahel

Overall objective: definition and deployment of an exchange mechanism for Carbon Credits to promote the growth of a market for eco-construction in the Sahel region of Africa



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The context

Housing in the Sahel, a major but neglected issue

Current housing conditions, and the construction sector in general, in Sahelian Africa are inadequate to provide for the well-being of local populations. and are not compatible with sustainable economic and climatic dynamics.

As a result of deforestation and the resulting scarcity of construction timber, traditional architectural practices are rapidly vanishing, and being replaced by inappropriate and environmentally unsound « modern » methods and materials (zinc or concrete roofs / concrete block walls) with poor thermal and acoustic properties, and reduced climatic resilience and longevity.

The construction sector relies on the extensive use of imported building materials with high carbon footprints, weakening local and national economies.

Adaptation of the construction sector, often neglected in public policies, is an essential priority which will have positive impacts on health, economics, education, employment, the environment and climate resilience for millions of Sahelian families.

The AVN Programme: track record and ambitions

Proposed alternative construction methods need to be technically simple and replicable and based on the use of readily available local materials and labour. In addition, by replacing the cost of imported materials with payment for local labour, mainly informal regional economies will be strengthened.

Since the year 2000 the Nubian Vault Association (AVN) has aimed to bring to as many people as possible in the Sahel an adapted « green » and bioclimatic low-carbon construction technique : the Nubian Vault (NV), principally based on the use of earth, a widely available resource, to make mortar and sun-dried mud bricks.

The diffusion of this alternative « archi-culture » involves a novel approach, namely the development of a NV market as a virtuous circle of local economic growth.

AVN's teams are experienced and well organised and deploy, with their partners, the implementation of the NV market in six countries of the Sahel. The overall programme has already completed over 4,500 construction sites in over 1,200 towns and villages , and trained over 800 masons in this « green » construction sector.

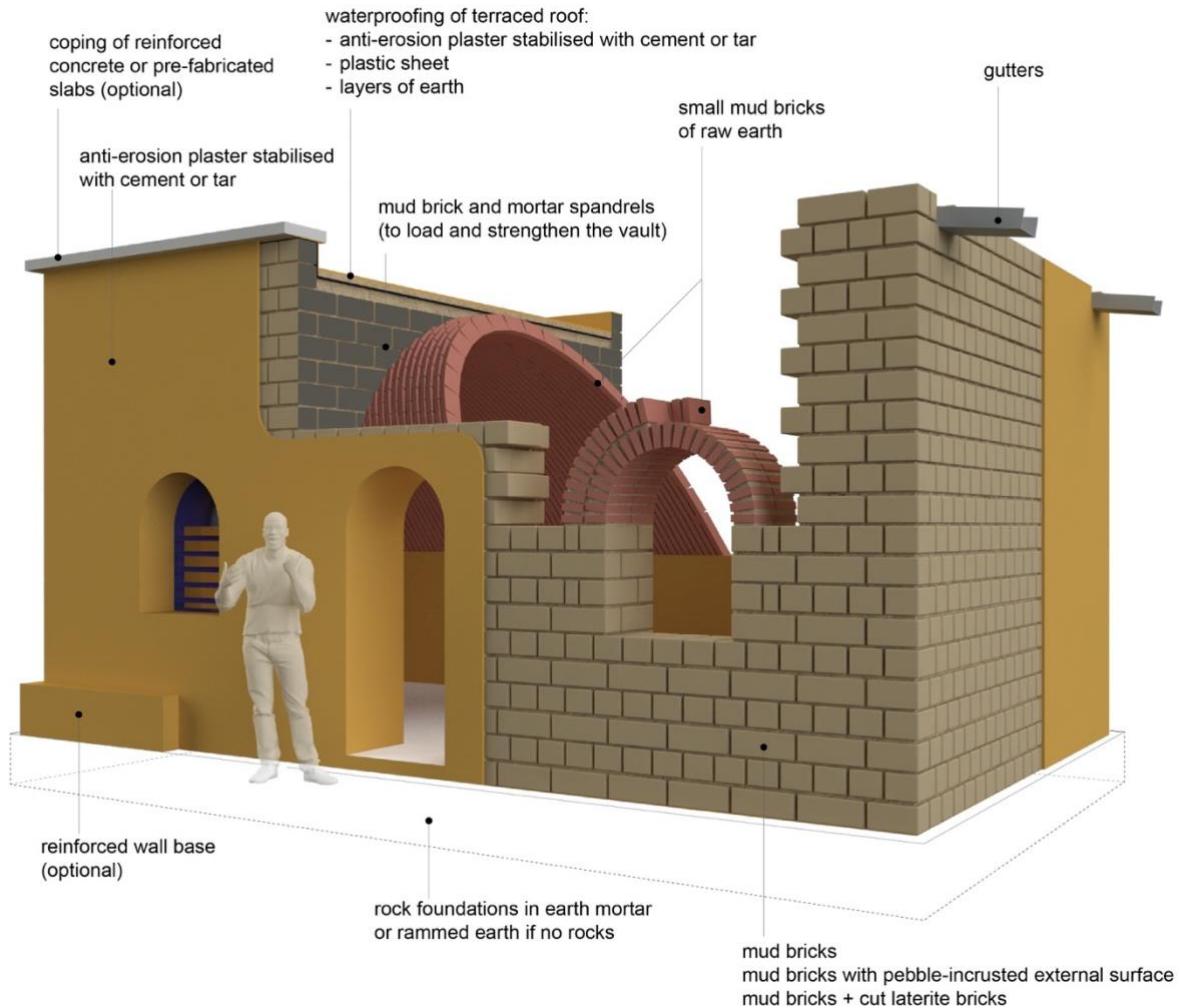
The Nubian Vault, a proven model of adapted bioclimatic eco-construction



The Nubian Vault technical concept can be summarised as being :

- **Durable:** resilient to extreme climate events. AVN and its masons have re-invented and developed low cost simple techniques for improving resistance to weather erosion of roofs and external walls, guaranteeing resilience equivalent to that of concrete buildings. The basic structure of a NV building has a life span of 50 years and more (the mud brick Nubian vaults at the Ramasseum in Luxor, upper Egypt, are still standing after 3,300 years!).
- **Comfortable and modular:** with excellent thermal, acoustic, and aesthetic properties, adaptable for multiple uses (e.g. roof terraces, two-storey structures).
- **Ecologically responsible:** no need for timber or straw, and eliminating or reducing the use of manufactured building materials with high carbon footprints, the NV is a technique essentially based on the use of locally resourced materials.
- **Economical:** excellent value for money, with a reduction of 30-40 % for basic structural costs as compared to an equivalent building with concrete block walls and a zinc or reinforced concrete roof.
- **Adapted to local economies:** using local labour and building materials, and the potential for self-build construction, thus re-injecting costs into local economic circuits.
- **Replicable:** a simplified and standardised technique using basic tools and which can be readily mastered without the need for academic schooling.

The many NV buildings constructed over the last twenty years (around 7,000 NV) bear witness to their solidity and durability. The growing demand from different clients (rural, urban, communal and institutional) and the interest shown by many different stakeholders demonstrate how relevant this « archi-culture » is to the realities on the ground.



The NV market, principal vector of diffusion of the NV concept

From the start of the programme, AVN has adopted a social entrepreneurship approach, emphasising the creation of a market for NV construction as the main vector for the large-scale diffusion of the NV concept and the demonstration of its relevance.

Based on an innovative methodology for inclusive professional training, at both technical and entrepreneurial levels, AVN has created a productive « green » construction sector. Demand is stimulated by awareness raising campaigns aimed at specific target groups, and by the deployment of favourable market conditions.

This market is well integrated into, and reinforces, both informal and formal local economic circuits. Its regular growth year on year (an average annual growth rate of 20%), even though insufficient to meet the total demand, demonstrates the relevance and value of the NV concept.

An effective territorial deployment methodology

AVN has developed a methodology for territorial deployment of the NV market which has been progressively enriched by experience on the ground. Based on testing of different operational approaches, the methodology has reached maturity through bringing together and standardising those approaches which best contribute to the rapid development of the NV market.

The methodology is structured around a « cascading » deployment, bringing together the functional integration of different actors in the target communities and the capacity to operate in difficult environments (e.g. with security or health issues).

The transfer of this methodology to partner organisations trained and accompanied by AVN and responsible for its implementation in their own territories has the potential to extend deployment of the NV market throughout the regions of the Sahel.

The territorial deployment methodology integrates three elements:

Awareness raising and accompaniment of different client groups (rural & urban – private and public)

Training & support of a production sector (apprentices, masons, artisans, entrepreneurs, technicians)

Mobilisation of all stakeholders within a business environment favouring market growth

With this concise and convincing methodological approach, AVN now has at its disposal a suitable and tested tool for a rapid and efficient multi-regional deployment and scaling up of the NV market.

Impacts on adaptation and resilience

By promoting access to solid, long-lasting and comfortable housing for Sahelian populations, the growth of the NV market makes a significant contribution to quality of life, adaptation, and resilience. The passive thermal properties (evening out temperature extremes) of dense earth architecture are undoubtedly the major advantage. These regions are amongst the poorest and hottest in the world, and thermal comfort is an essential element of adaptation to these conditions, allowing for a « good life » and significant health benefits.

To these impacts can be added the consolidation of regional economies and the training of (mainly rural) youths and their employability in a promising new sector, especially during the long dry season, giving them a more secure future. The mobilisation and increased competence of local operators is also worthy of consideration.



A « Nubian » family in front of their 25 m² NV house

Environmental and mitigation impacts

The environmental impact of the NV concept is one of the least damaging of all the architectural techniques currently used in Africa. The main structure of a NV building only requires basic tools and the use of local and widely available raw materials requiring minimal transformation. AVN takes care to support institutional actors in proper site management with a view to insuring zero long-term environmental impacts. The NV construction technique does not result in the production of any waste products and has an excellent « grey energy » rating.

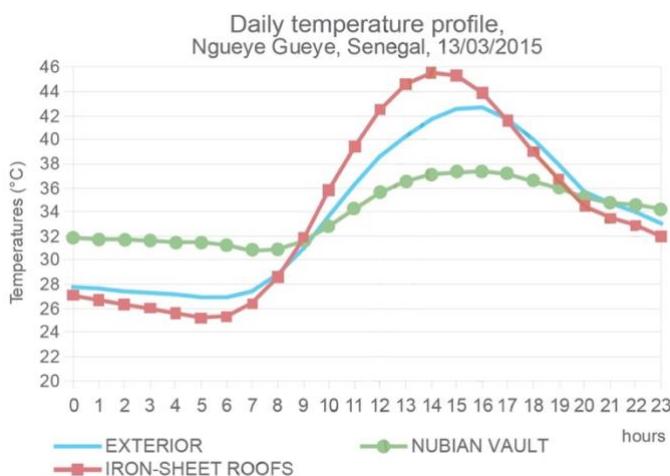
NV construction does not require any use of timber resources and reduces considerably the need for exogenous building materials with a high CO₂ footprint, industrially produced and / or requiring long distance transport (steel girders, zinc metal roofing sheets, cement, sand, gravel etc.).

Several comparative thermal measurement studies carried out since 2007 in Burkina Faso and Senegal confirm the subjective reports of increased thermal comfort made by NV clients. The good passive thermal performance of NV buildings are associated with a significant reduction in electricity consumption for ventilation and/or air conditioning.

The first comparative measurements of the thermal comfort of the various types of buildings and of the materials used for their construction, and the quantification of the resulting benefits in terms of CO₂ equivalent reductions generated by the NV concept produced the following figures :

- a flattening of average annual temperature extremes of 5 - 7 °C;
- cold discomfort (temperature < 20°C) very rare or nonexistent ;
- extreme heat discomfort (temperature > 37 °C) significantly reduced as compared to a building with a zinc or concrete roof ;
- the construction of a NV and its use over a 30 year period under acceptable conditions of comfort leads to a saving of **0,8 t eq CO₂ per m²**, of which 20 % is due to the construction process, and 80 % for usage ;
- the replacement of traditional architecture using timber beams by a NV leads to the saving of 0,164 trees / m², namely 4,1 trees for a NV of 25 m².

It is reasonable to estimate that, by 2020, the NV programme has led to a reduction of **150,000 - 160,000 t eq CO₂**.



The importance of scaling up the growth of the NV market

The average annual 20 % growth rate of the market demonstrates the relevance of the NV concept, but is not sufficient to solve the housing problems of the majority of the populations of the Sahel. **It is essential that we identify the levers that, in the short and medium term, will achieve growth rates leading to a significant penetration of the construction market in the Sahel.**

Financial incentives for eco-construction - the main lever for growth of the NV market

Following the example of the use of financial market incentives for environmentally positive products (e.g. in the construction and transport sectors) in Europe and North America, AVN has been piloting since 2016 the use of financial incentives to encourage uptake of the NV concept. These have been aimed at AVN's key target groups of rural clients, for whom between 70 and 80 % of all NV buildings are constructed. The leverage effect of such incentives for these clients has been clearly demonstrated.

These rural clients, many of whom are subsistence farmers, are able to provide local materials and unskilled labour « in kind » for their NV projects, but are often unable to pay the salaries of the NV artisan mason and his team, purchase items such as doors, windows, and flooring. Providing an incentive of around 15 - 20 % of the total cost of a NV is often enough to allow many rural clients the chance to undertake an eco-construction project, mobilise family support whilst guaranteeing the salaries of the specialist NV workforce.

For a house of 25 m² (AVN's standard base unit, corresponding to the average size of a rural dwelling) the amount of the financial incentive is **270 €** plus a further 100 € for its implementation, control, and recording, making a total of **370 € per Sahelian family to get access to decent bioclimatic housing.**

AVN and its field partners have the capacity to propose, distribute, monitor, control, and record these incentives and their proper allocation.

The effects of climate change, for which they bear no responsibility, impact these communities disproportionately, and yet they fail to benefit from any of the « positive dividends » (consumer goods, well-being, economic growth etc.). This situation legitimises the use of such financial incentives to improve their resilience and adaptation to climate change.

Financial carbon offsetting measures to support NV eco-construction incentives

The link between the climatic and environmental performance of the NV concept, the necessary growth of its market and the leverage potential of eco-construction incentives for rural clients having been established, it is pertinent to **couple it with financial measures allowing for carbon offsetting.**

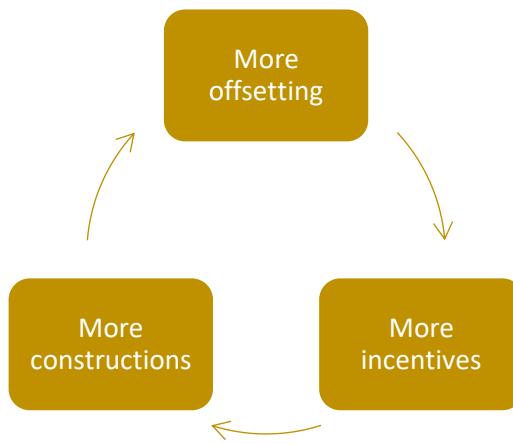
The implementation of a dynamic exchange between, on the one hand, rural Sahelian families able to offer mitigation of greenhouse gases (GHGs) by their construction methods and the de-carbonisation of their homes and, on the other hand, the corporate, institutional, and individual stakeholders wanting to invest in carbon offsetting products, could be achieved through a visionary, ambitious, and exemplary operational project.

The Project

Pertinence

The pertinence of the project is based on the following premises:

- **The populations of the Sahel desperately need adapted architectural solutions** promoting their well-being and resilience in the face of climate change and population growth;
- **An alternative adapted and proven eco-construction technique, the NV concept, exists.** AVN and its partners are implementing a deployment methodology for the NV market, the main vector of the concept;
- **Growth of the NV market is significant, but insufficient to meet current and future needs.** This is particularly true for the rural populations of the Sahel, the core target group of AVN's programme;
- **The distribution of financial incentives for NV eco-construction has shown its strong potential for enlarging the NV market,** generating scaling up and ancillary impacts;
- **The GHG mitigation potential** of « green » NV buildings for rural clients has an **attractive exchange value** in the carbon offset market;
- **This carbon value, offered on the carbon compensation market, can be used as a financial incentive** for bioclimatic construction for rural clients. Such incentives will encourage potential clients and considerably increase the number of rural families opting for NV buildings;
- **This exchange mechanism is part of an iterative virtual circle** because the valorisation of this carbon mitigation potential allows for its duplication:

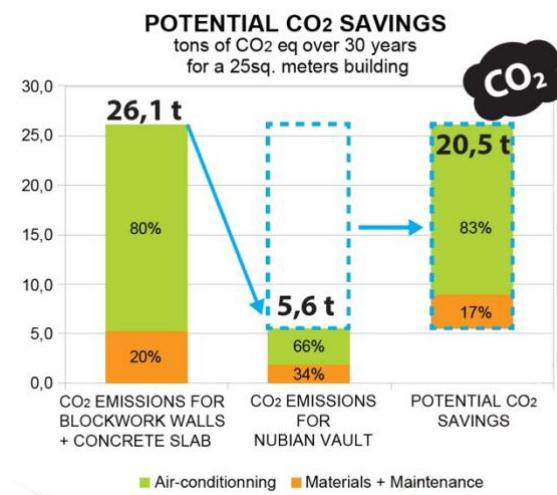


It is also an exemplary demonstration of the legitimate use of carbon compensation in the service of the development of energy efficient adapted technologies with significant ancillary benefits.

Carbon benefits calculations

The estimates of greenhouse gas reduction by NV used by AVN are based on a 2015 study by Bruno Jarno (« *Étude portant sur la technologie Voûte Nubienne comme modèle de construction* »¹), carried out for the Senegalese Ministry of the Environment and the Global Environment Facility. It evaluates the environmental gains of the NV technique in both construction and usage phases (passive energy effectiveness), the latter over a 30 year service life, including maintenance and replacements of building components (ISO 14040 Standard).

The study shows a NV generates an environmental gain of 0,8 t eq CO₂ / m², namely 20 t eq CO₂ for a standard rural NV house of 25 m². when compared to various other contruction methods currently in use in Senegal. 83 % of these gains are attributable to the 30 year usage period, and 17 % to the construction phase.



Ancillary benefits

Many ancillary benefits, included in many Sustainable Development Goals (SDGs), can be added to the mitigation impacts mentioned above in the context of community adaptation and resilience; the most obvious ones are:

- **Amelioration of living and housing conditions** (principally for women and children);
- **Professional training and employability of vulnerable rural youths** and more widely, for a « green » construction sector;
- **Strengthening of local economies** (local re-injection of construction costs);
- **Mobilisation and upskilling** of local development actors;
- **Mobilisation of institutional actors** in the evolution of the construction sector and inclusion of this sector in their development plans.

¹ https://www.lavoutenubienne.org/IMG/pdf/15-04-17_rapport-final-gef_technologie-vn_bj.pdf

The foundations of a NV Carbon Credit market

Several operators have already recognised the value of NV Carbon Credits (NV-CC) either by acquiring them to offset their own impacts (World Habitat - UK), to resale on the Carbon Credit market (Planetaire - Canada), or by supporting their development in the context of an international cooperation programme (Government of Québec – *Programme de Coopération Climatique Internationale / PCCI*).

Certification of the carbon credits

Different certification organisations exist in the market that propose a wide variety of approaches and requirements, the most widely recognised being the « Gold Standard » certification. However, the high cost of the certification process in the voluntary market is the main obstacle to the development of new projects, being financially accessible only to projects already producing a critical mass of Carbon Credits (CC) and able to justify the high initial investment needed. In AVN's case, the currently limited number of CCs is combined with the absence of a quantification methodology appropriate to the construction sector in Africa. The creation of such a methodology is an essential preliminary step, the cost of which needs to be added to the costs of a standard certification. Furthermore, these certifications are based on *past* CC values, whereas AVN's approach includes in its calculations the estimated *future* GHG performance over a 30 year lifetime of the buildings (AVN's hypothesis for a NV building's duration, to be validated). Accordingly, AVN has chosen to defer the certification process and to operate for the moment through a CC exchange mechanism which, based on credible and referenced studies, will allow for a rapid upscaling of the production of carbon reductions.



A rural Nubian Vault house in Mali

The quantification methodology in depth

Definition of a protocol

Based on this first study AVN wishes to develop a quantification protocol based on the ISO 14064-2 Standard (which provides the specifications and guidelines for the quantification, monitoring and declaration of reduction of emissions, or increases in the suppression of, greenhouse gases).

This protocol will be based as far as possible on existing carbon methodologies to calculate the anticipated reductions of greenhouse gas emissions resulting from the construction and usage of a standard 25 m² NV house in rural areas of the Sahel (Burkina Faso, Mali) compared to a baseline scenario (*versus* the other main construction techniques common in rural zones of the Sahel). The protocol will take into account both the construction phase and a 30 year usage phase, taking into consideration the cooling requirements necessary to obtain an acceptable level of comfort (suppressed demand concept). It will then be applied to calculate the expected reduction in emissions of a standard NV house.

The protocol will clearly and rigorously explain the quantification methodology to support the credibility of the calculations. The protocol and the calculated Emissions Reduction (ER) will be used as scientifically-based marketing tools, and not necessarily leading to certification in the short term. It will be a reference instrument for the ER value of a standard NV house, to be used by stakeholders wishing to invest in a carbon neutral approach through carbon emissions trading, and by rural clients in the Sahel as a means of proving the reduction of emissions resulting from their investments in low-carbon housing. In line with the evolution of the sector, the protocol will be a key element of the overall validation of the « adaptation » benefits of a NV building, in particular with respect to Sustainable Development Goals (SDGs).



Protocol specifications

Below are the proposed specifications for a reference document laying out the methodology for calculating the reduction of greenhouse gases attributable to the construction and 30 year usage of a NV of 25 m² in the Sahel (Burkina Faso, Mali).

1) Draw up a protocol for measuring the anticipated GHG emissions reduction linked to the construction and 30-year usage phases of a standard NV house (25 m²), based on existing methodologies and the default values in the ISO 14064-2 Standard.

- Define the structure of the accounting protocol based on ISO 14064-2 and identify all relevant items;
- Identify applicable existing carbon methodologies (CDM, Gold Standard, VCS, ...);
- Define a methodological approach for ex-ante emissions reductions calculations for NV houses;
- Verify existing data and identification of applicable default values;
- Define applicability criteria for the accounting protocol;
- Determine baseline and project scenarios, sources of eligible GHG emissions and potential sources of leakage;
- Compile the accounting protocol in a final document.

2) Use the protocol to calculate the expected reduction in emissions for a standard NV house.

- Gather data and input values for ER calculation;
- Define concrete baseline and project scenarios, the sources of GHG emissions and of leakage for Burkina Faso;
- Create ex-ante calculation tool for expected emissions reductions based on accounting protocol;
- Compile report for estimation of emissions reductions.

3) Make recommendations with a view to consolidating the data used in the calculation of emissions reduction.

- Identify the values used in the calculation that are based on insufficiently representative assumptions or data;
- Evaluate the degree of uncertainty generated by these values and the margin of error entering into the final result;
- Propose studies and/or measures to progressively reduce the margin of error.

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- **Strengthening of local economies** (local re-injection of construction costs);
- **Mobilisation and upskilling** of local development actors;
- **Mobilisation of institutional actors** in the evolution of the construction sector and inclusion of this sector in their development plans.

Business model for a NV Carbon Credit Market

Trading values of NV Carbon Credits

The NV project includes the payment of financial incentives to Sahelian families building standard NV houses of a minimum size of 25 m².

The amount of the incentive currently **paid to beneficiaries** is **270€** (representing between 15 - 20 % of the total construction value and around 80 % of the necessary cash payment). To this sum is added 100 € to cover costs of distribution, monitoring and capitalisation.

So, for a NV house of **25 m²** generating a reduction of **20 t eq CO₂** and a total incentive cost of **370 €**, we arrive at a cost of **18,5 € / t eq CO₂**.

In addition:

- A reduction in price could be offered to purchasers of large quantities of CC;
- It will be necessary to foresee commission and marketing costs for re-sellers;
- It will also be necessary to foresee verification and monitoring costs by external operators;
- Co-financing by Foundations concerned with environmental issues could be sought to help bring the costs of CC under control.

An online registry of NV Carbon Credits (NV-CCs)

AVN controls the production NV Carbon Credits and guarantees their recording in a registry linked to an online mapping tool, leading to a dynamic inventory of the state of stocks and exchanges. Each standard NV house (equivalent to 20 t eq CO₂) will be given a reference number linked to its geo-localised site, so that each investor will be able to find online photos and information concerning their emissions trading. This register, managed by AVN, should be subject to external audit.

The position of stakeholders

Sahelian families building NV houses are the legitimate owners of the associated Carbon Credits generated through their investment in bioclimatic construction. They can exchange these mitigation benefits for cash incentives through emissions trading with carbon neutral subscribers.

AVN positions itself as an intermediary between the Sahelian families producing and holding NV Carbon Credits and the various stakeholders purchasing the CCs on the basis of a contract with the producer stipulating receipt of a financial incentive and a commitment to use and maintain their NV building over a 30 year period. AVN will offer these NV-CCs directly in the voluntary market and can also authorise their transfer rights to other operators. Through its robust distribution, monitoring and recording procedures, AVN can guarantee the validity and integrity of the trades and the follow-up of their production and allocation.

Carbon traders can also obtain NV-CCs directly from AVN to distribute through their own networks. AVN can also provide the tracing of the distributed Carbon Credits.

Various entities will acquire NV Carbon Credits to mitigate their emissions as part of a carbon neutral approach:

- Businesses subscribing to the NV market approach and the emergence of green eco-construction sector proposed by AVN and who would like to offset their GHG emissions by supporting this example of social entrepreneurship;
- Institutional actors (communes, municipalities, regions, etc.) who want to help their equivalents in the Sahel over issues of housing and adaptation of the construction sector to climate change through their carbon credit investments;
- Private individuals involved in mitigation efforts and who acknowledge the role played by families in the Sahel « producing » carbon credits and associated ancillary benefits through the adoption of the NV concept.



A Nubian Vault construction site

Marketing and communication

The implementation of a dynamic exchange system for NV-CCs requires a structured and increasingly ambitious shared marketing approach.

- The NV Carbon Credit product, its mitigation value and its relevance in terms of adaptation and resilience will be promoted through a range of marketing approaches: mailings, dedicated web, pages, social media, publications etc.;
- A system to provide assurance to the purchasers regarding the value of their NV Carbon Credits purchase, through their monitoring, production, and transfer;
- The features of the product (direct signposting of producers/ beneficiaries, the multiple ancillary benefits, its novel features) will be highlighted.

Several specific tools need to be strengthened and/or developed:

- A digital register of verified NV Carbon Credits and the archiving of all monitoring and control documents (transfer certificates, geo-localised photos, etc.);
- An interactive database showing the location of the beneficiaries of the incentives, their NV buildings, and the transfer documents;
- Web pages for calculation of carbon footprints, information on the NV Carbon Credits product, available stocks, online exchanges etc.;

The development of the marketing of these NV Carbon Credit exchanges should be carried out on a collaborative basis. AVN does not want to be the sole intermediary between the producers of eco-construction carbon credits and the entities engaging in carbon neutral policies. Development partners and CC traders are to be involved in this novel mitigation product.



Control of the production of NV-CCs and registration of exchanges

The production and exchanges of NV-CCs will be controlled and registered by AVN

Local operators (AVN's regional offices, operational partners, contractors) offer the incentives within rural communities and, where necessary, put potential clients in contact with NV artisan masons.

There is effective monitoring of the NV construction sites. When the NV building is completed, the operator responsible for the financial incentive will check the completed structure and the payment by the client for the skilled labour provided by the NV artisan mason and his team. If all is well, a certificate of allocation of the financial incentive and the transfer of associated carbon credits is signed by both parties and the incentive is paid to the beneficiary against a signed receipt. A geo-localised and digitally dated photo is taken at the same time.

The various documents (transfer certificate, geo-localised photo, payment receipt) are then sent to AVN's national Production and Admin/Finance centres. Each construction is allocated a code number and is registered, with the accompanying documents, in two different tools - the NV-CC registry and the digital marketing / capitalisation tool (which records the entirety of the Programme's production). All this information is centrally checked at AVN's head office and then entered in the digital cartographic database.

Random spot checks are carried out on a proportion of NV construction sites at both regional and national levels, and the register of NV-CCs will be externally audited.



Aerial view of the NV village of Diakré (Mauritania)

Conclusion

This document should demonstrate the pertinence, importance and effectiveness of linking the carbon savings resulting from new eco-construction practices in the Sahel to the financial incentives which have the potential to significantly upscale and multiply the growth of the NV market and its associated impacts.

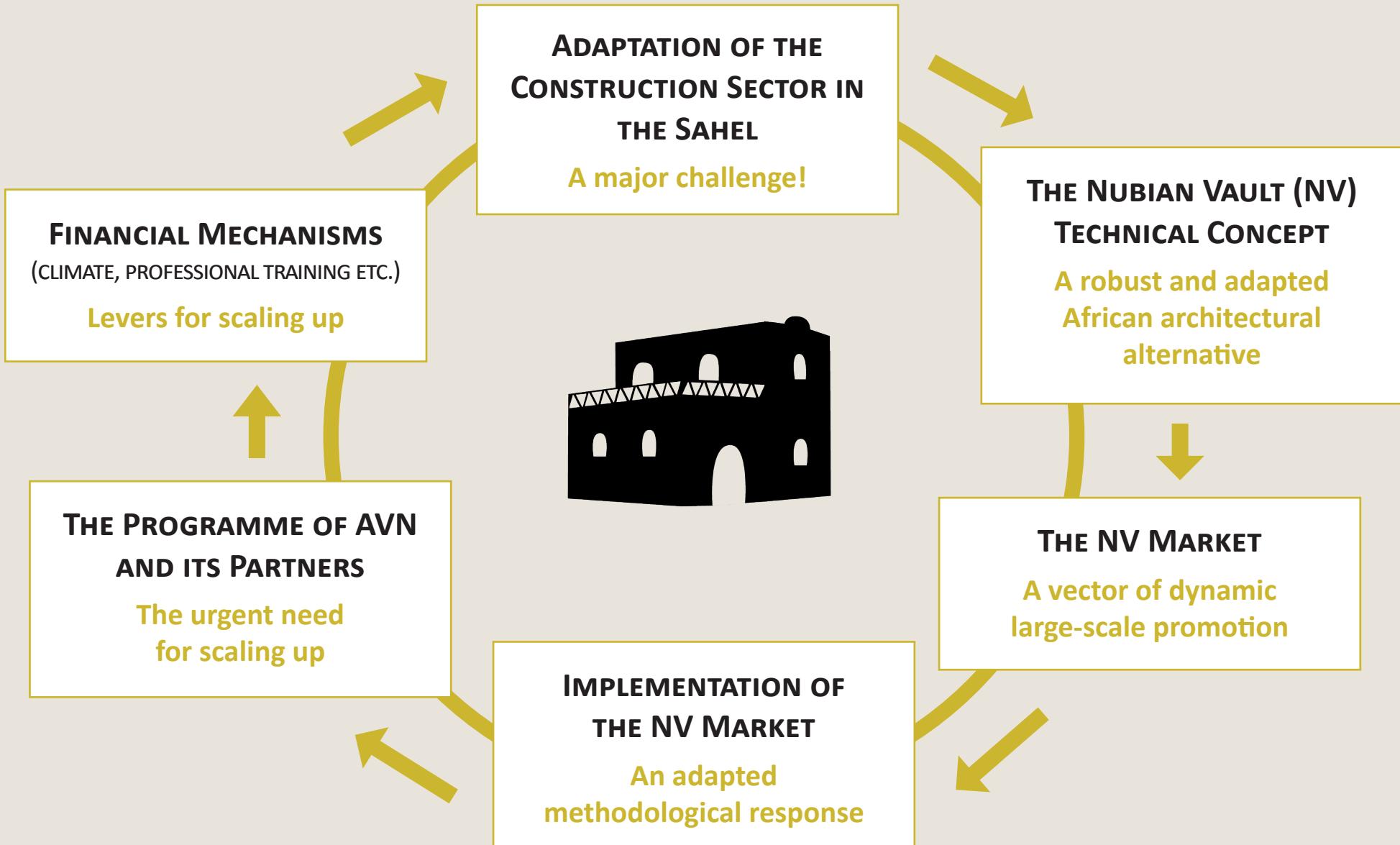
The project proposed here refines the definition and deployment of this exemplary approach, demonstrating that **the exchange of carbon credits can both help in the mitigation of the effects of climate change as well as in the adaptation of the local populations who are suffering from these effects.**

AVN invites all the stakeholders interested in this novel approach to support and invest in our project.



A NV construction site

DYNAMICS OF THE PROGRAMME OF THE NUBIAN VAULT ASSOCIATION (AVN)



THEORY OF CHANGE - THE NUBIAN VAULT ASSOCIATION (AVN)

IMPACTS

Sustainable Construction Sector - Jobs - Better Housing - Health - Climate Change Adaptation and Mitigation - Local Economies

OBJECTIVE

A SIGNIFICANT, INTEGRATED, INCREASING AND HIGH-GROWTH SAHELIAN GREEN CONSTRUCTION MARKET

NUBIAN VAULT MARKET

Informal/Formal - Rural/Urban - Private/Community
including Self-build - Social Housing - Emergency Housing - Public Buildings



Sustainable Construction Sector - Jobs - Better Housing - Health - Climate Change Adaptation and Mitigation - Local Economies



CLIMATE DYNAMICS OF PROVIDING INCENTIVES FOR THE PRIVATE RURAL NV MARKET

