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# The green economy and sustainable agriculture: A case study of Gnostic Agritech Limitless

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**Abstract**

In this exploratory study, we provide a synthesis of the state and the market and argue that productive investment in indigenous agroecological systems provide the strongest impulse to entrench the virtues of the green economy and graduate out of poverty. The paper argues that private sector led, small scale, soundly managed community driven projects, tempered by public sector investments in infrastructure provide opportunities to harness the forward and backward linkages in both industry and agriculture. Moreover, development driven by local economic imperatives yields a higher utility compared to centralized production, distribution, exchange and consumption. Using a novel Ghanaian experiment, the Gnostic Agritech Limitless, this article draws lessons for national and regional industrial and agricultural policy.

**KEYWORDS:**
Green economy; Agriculture; Developing countries; Ghana.
**JEL:** L00, L6, L5, O5, O14, O5

## 1 | AGRICULTURAL MODERNISATION FOR SUSTAINED INDUSTRIAL DEVELOPMENT IN GHANA

Agriculture remains a key sector for the rapid transformation of the Ghanaian economy. According to the most recent estimates from the Ghana Statistical Service, in 2021, the share of agriculture in Ghana's GDP was 19.7%, while industry contributed approximately 28% with the services sector leading with 45.9%. The preponderance of services in the GDP mix is a symptom of a dysfunctional economy where the productive forces are arrested and imprisoned while the most superficial aspects of the economy hold sway. The colonial economy was designed to cultivate a raw material base to feed the industries of the metropole, and in turn use it as a dumping ground for the industrial goods. Like many parts of the African continent, that relationship has not changed, even after political independence, except for a few breathing spaces when the nationalist leaders wrested power from the colonialist. Industrial development in Ghana took off on a massive scale under the government of Dr. Kwame Nkrumah. Nkrumah's Seven Year Development Plan (1963/64 to 1969/70) argued that the limited private sector at the immediate post-independence era did not offer the critical mass required for industrial expansion. Consequently, a well-organized public sector is better placed to marshal the needed resources to create the large-scale infrastructure that will spur private individuals into action by responding to the initiatives, productive incentives, and market signals. The seven years blueprint therefore provided quantitative targets and measurable outputs for national progress and prosperity, but also for the advancement of the African continent. The founding fathers and mothers appended their very lives to the document to create a strong and progressive society in which no one will have anxiety about the basic means of life, work, food and shelter; where poverty and illiteracy no longer exist and disease is brought under control; and where educational facilities provide all the children of Ghana with the best

possible opportunities for the development of their potentialities (see NDP, 1963). This ideal still rings in the hearts and souls of Africans and after seven decades of independence this illusive pimpernel needs critical examination.

The modernisation of agriculture and the rapid expansion of industrial activity is still the key to opening doors and new vistas of development in Ghana. The facts are not too difficult to establish. Agriculture accounts for 61% of all employment in Ghana: in other words, about two out of every three working people in this country make their living out of farming, forestry and fishing, and 50% of GDP in the immediate post-independence era was derived directly from agriculture. Even though the sectors contribution has waned in the 2000s agriculture remains the dominant sector of the Ghanaian economy, employing about 40% of the total work force and accounting for more than a third of national output. An agricultural revolution is therefore a precondition for sustained industrial revolution and national development plans ought to attune to this reality. A prosperous agriculture provides the market for the consumer and producer goods which the industrial sector sells. Industry in turn produces the tools and machines needed for agriculture. As productivity in agriculture improves, labour is released to industry creating a perfect balance for the two sectors. In addition to providing the markets, the capital and the labour for industrialisation, agriculture must also fully aim at supplying domestic industry with raw materials such as cotton, non-apparel fibres, sugar cane, rubber and cocoa.

Sound agricultural development is part of the Africa Union's Agenda 2063 vision for inclusive growth and sustainable development. The Comprehensive Africa Agriculture Development Programme (CAADP) and its sequel, the Malabo Declaration (2014 to 2025) on Accelerated Growth and Transformation for shared prosperity and Improved Livelihoods requires new interventions, bold departure from industrialised conglomerate food production and animal husbandry based on antiquated and backward synthetic methods. African grown agricultural solutions, embedded in traditional production methods, and community control of the factors of production holds the key to boosting intra-African trade and enhancing resilience of livelihoods and production system to climate variability and other related natural shocks. The Gnostic Agritech Limitless (GAL) is a fifth world radical system of farming and farm enterprises based on high productivity and production, value addition and the rational transmutation of primary produce to their highest state for final use. It reestablishes the preeminent role of agriculture as the highest wealth multiplier. Gnostic Agritech Limitless is deeply rooted in indigenous intelligence, and the circular economy transformation of inputs to output, and the blend of modern and ancient methods of food production, and animal husbandry. The GAL agroecology system has indigenous and modern themes, innovative finance, and mechanisms for boosting production and managing post-harvest losses.

## 1.1 | Indigenous Agriculture

Relying on locally available resources and inputs in the agricultural value chain is GALs focus. The use of naturally occurring compounds in the farm ecosystem coupled with the sympathetic forces of nature such as the influence of the stars in the conception, gestation and harvesting of farm produce satisfies the circular economy approach to production, distribution, exchange, and consumption. The indigenous systems of farming employs exoteric and esoteric principles in farm management, soil conservation to bring about wholesome food in a well-balanced ecosystem. GAL treat animals, crops, and soil as a single entity, the development of new local breeds and varieties. This is a potent answer to the quest of UN SDG 13 on climate action, in mitigating climate change via reducing emissions, recycling resources and prioritising local supply chains. Through GALs Indigenous Seed Bank which collects, harnesses, and distributes seeds that are naturally adapted to an area for revegetation of disturbed sites, the need for petroleum-based synthetic pesticides and fertilizers is eliminated. Native breeds and seeds have a direct impact on soil health as they do not deplete the soil of its nutrients. Indigenous techniques of soil conservation employ methods and practices adopted by native or local communities to protect and preserve the quality and fertility of the soil. These practices are often rooted in traditional knowledge and cultural practices that have been passed down through generations. Mulching helps to minimise soil erosion, and reduces the impact of raindrops, thereby preventing moisture evaporation, and maintaining a more stable soil temperature. Practiced widely in GAL's Meta Farms network, mulching improves soil structure, enhances water infiltration, and suppresses weed growth. This does not only reduce the labour required to till a given piece of land, but also help regenerate the soil for sustainable farming with an added benefit of improving farmer incomes. In weed and pest control, GAL uses traditional and natural methods to manage and eliminate weeds and pests in agricultural settings, instead of relying on synthetic chemicals or pesticides. Some of techniques include crop rotation, companion planting, biological control (using natural predators or parasites), and cultural practices that promote a healthy and balanced ecosystem. Indigenous methods of weed and pest control have been practiced for centuries by indigenous communities and often prioritize sustainable and environmentally friendly approaches. Development of new compounds for soil health and soil nutrition pioneed under GAL. The farm food

product is an organic substitute to chemical fertilizer. It works by replacing the nutrients lost through suffocating microorganisms by chemical warfare on the land. It replaces all the organisms lost in less than two years of constant application and proper agronomic practices.

## 1.2 | Virtual and augmented reality platform for management, monitoring and coordination.

Although Africa has about 60% of arable land and a well-endowed youthful workforce, over 20% of the food consumed is imported. According to the International Food Policy Research Institute, Africa spends between $30 and $50 billion on food imports, which could increase to $150 billion by 2030. Part of the shortfall in food production is the antiquated technology, the impact of climate change which has resulted in significant shifts in the concentration of crop and animal species in the semi-arid regions of the continent. Climate change for instance has disrupted rainfall patterns and affected both the quantity and quality of food in Africa's agriculture. Rising temperatures, extreme weather events, and reductions in water availability have resulted in reduced agricultural productivity. To overcome reductions in agricultural productivity, GAL has implemented comprehensive smart agriculture in the form of Internet of Things (IoT) in some of its farms in Ghana to support all year-round farming to promote food security. The design and construction of small-scale earth dams, deployed through smart farming irrigation systems to monitor light, humidity, temperature, soil moisture are incorporated in the new farming systems of GAL.

Feasibility studies conducted by the School of Meta farming of the Nile Valley Multiversity indicates that cconstruction of small reservoirs for irrigation holds a great deal of rewards for low income and rural communities. The special appeal of small reservoirs is that; (i) their construction requires comparably little expenditure (ii) they represent an adequate tool to manage freshwater storage and promote all year-round farming (iii) They spread throughout an area and reach a wide population (iv) they are better managed and give indigenous farmers full control over the water. The creation of community farm dams with IoT embedded for monitoring and execution of vital farming functions that promote plant and animal health and increases output provides a potent solution to Africa's food security bottlenecks, opening the channels for abundant supply of food all year round. Water is life, is not just a cliché but a palpable reality under the GAL agroecology system. By Merging indigenous technology with modern technology, GAL makes farming a first choice for wealth creation among the youth and educated sections of society. This builds resilience in the local agri-food system and enhances food security.

Adding value and scaling modern agriculture to create opportunities for equitably distribution of wealth is the next step of the GAL experiment. Supporting economic livelihood through raising on-farm productivity, by reducing the drag in agriculture from the application of modern technology in planting, harvesting and land preparation, ensures rural incomes and employment are enhanced. Powered through solar devices, and supported by rural internet solutions, the GAL system contributes to food security in a scalable format for the new revolution in Africa's agriculture. With a smart agriculture framework farmers can monitor their farms from anywhere. This paves the way for changing conventional peasant farming into a large-scale organic operation with replication potential for the entire continent.

## 1.3 | Financing agriculture using innovative pathways

The success of agriculture hinges strongly on an input credit system provided by both the public and private sectors. A well-grounded agricultural input credit, provided by financial institutions or other credit providers, enable farmers to access essential inputs such as seeds, fertilizers, pesticides, machinery, and equipment for farm operations. With agricultural input credit, farmers can invest in improved farming techniques, modern technologies, and better-quality inputs. This can help streamline operations, enhance efficiency, and ultimately increase yields and profits. One of the teething problems in Ghana's agriculture in inadequate assessment and management of risk. Given that farming is susceptible to various risks, such as weather changes, pests, and diseases, aadequate credit facilities allow farmers to mitigate these risks by investing in better farming practices, diversification of crops, and acquiring crop insurance policies. By utilizing agricultural input credit effectively, farmers can enhance crop yields, improve quality, and potentially access higher-paying markets. This can lead to increased income potential for farming households.

A large amount of agricultural input is often either wrongly targeted thereby limiting its impact, and/or appears as the wrong kind of support for the right farming enterprises. The first phase of Ghana's Planting for Food and Jobs increasingly focused on input subsidies on fertilizer. While this is important in increasing yield temporarily, its long-term viability cannot be assured. For instance, fertilizer application rate increased from 8 kg/ha in 2016 to 25 kg/ha in 2022, and the distribution of certified seeds from 2,000 MT in 2016 to 36,000 MT in 2022 under the Planting for Food and Jobs programme. Consequently, agricultural sector grew

from 2.7% in 2016 to an average of 6.3% from 2017 to 2021, with significant improvement in the cultivation of major food staples such as maize, cassava, and plantain (see MoFA, 2023). Although subsidies alone cannot explain the increased performance in food production, the subsidy programmes succeeded in raising input use by farmers and increasing agricultural productivity in many cases. However, agricultural subsidies everywhere tend to be extremely expensive, and most subsidies tend to benefit relatively well-off and better-connected farmers. Fertilizer subsidy programmes have been found to be prone to inefficiencies arising from high administrative costs, government monopolies and political manipulation (Banful, 2010). According to Banful (2010), around 50% of market fertilizer prices across Africa can be attributed to transaction costs. A study by Laborde et al (2020) confirmed that a significant part of agricultural support relies on policy instruments that are environmentally harmful and generate increased greenhouse gas emissions (GHGs). The long run debilitating effects of interventions by government using wrongly targeted subsidies to promote environmentally unsafe chemicals and hybrid seeds to increase crop yield and modernize agriculture has no future in a renewed planet able to throw off pollution and destruction off her body. This type of intervention demands high budgetary strain on the government heightening an already limited access to agricultural credit.

GAL's network of Meta Farms across Ghana employs several innovative finance schemes to circumvent the agricultural credit conundrums. Through the Nabiya Kapital Foundation, groups of well organised farmer cooperatives access interest free loans to purchase seeds, fertilizers, equipment, or for investing in small scale irrigation systems. Repayments can be in cash, after harvest or in kind through farm produce. The cooperatives enable farmers to pool their resources together to access financial services, such as credit and insurance. By joining forces, farmers are able to negotiate better terms and reduce transaction costs, as well as adopt crop insurance that protects them against losses caused by unpredictable events like droughts, floods, or pests. This helps farmers manage risk and secure their investments.

Nabiya Kapital also supports impact investors to provide capital to agricultural projects that have social and environmental benefits. These investments aim to facilitate sustainable farming practices, improve food security, and promote rural development. At the same time, innovative funding schemes such as crowdfunding platforms have been deployed to allow individuals or organizations to raise funds for specific agricultural projects. Farmers use these platforms to attract investment for innovative farming techniques, equipment, and value-added products. These innovative financing products contribute to the development of the agricultural sector by increasing access to capital, promoting sustainability, and reducing the financial risks faced by farmers.

### 1.4 | Metawarehousing and logistics hub (MWLH)

The MWLH is GAL answer to post harvest losses, vagaries in food prices and uncertain farmer incomes. In Ghana, about 20% to 30% of cereals and legumes and roughly 20% to 50% of roots, tubers, fruits, and vegetables are lost in storage, during transport, or at the market (see Rutten and Verma, 2014). While pests, diseases, physiological and environmental factors are partly at play in the post-harvest losses conundrum, storage infrastructure and processing constitute a big hurdle to transforming agriculture. Reducing food losses and waste is the second pillar of the GAL system. The warehousing scheme, manned and managed by highly educated Supply Chain Specialist provides a solution to the perennial agriculture marketing problem of price fluctuations and attracts vital funding for food production and sustainable food security. GAL Warehousing schemes uses an integrated consumer to business, and business to business models in its supply chain, enabling a wide variety of end users to be served in the various cities, towns, and villages. Adequate storage infrastructure stabilises food prices and farmer incomes by maintaining an uninterrupted supply of agricultural commodities during the off season. From the GAL warehouses distributed throughout the country food processing industries take their orders, while the distribution and marketing are regulated to ensure regular and adequate supply of major food throughout the year.

## 2 | HOW THE GAL SYSTEM WORKS

GAL has expertise in farming and farm enterprises through the Nile Valley Multiversity School of Meta Farming. Renowned scientist, agronomist and extension officers, implement practical input reduction techniques to reduce and eliminate dependency on purchased costly synthetic products in the food chain in order to lower the cost of production for farmers and conserve significant amount of farmer return on investments. By switching to organic manure, compost and naturally occurring organisms for soil nutrition, and the use of sympathetic forces to balance nature in disease and insect and pest, farmers can save up to 43% of income that they would have otherwise been spent on buying synthetic compounds which have a long-term damaging effect on farmer health and the environment. Recent analysis of post-harvest interventions in food and meat storage indicates

substantial savings of more than 67% in one warehouse in the Bono East Region. Future evaluation studies of the entire range of interventions from farm to fork would yield great utility for researchers and provide avenues for expanding indigenous farming as a counterbalance to the negative cycle of synthetic agriculture.

Carefully planned and managed rich and diverse ecosystems that create synergies between different components of the agricultural system informs the operations of the small- and large-scale agroecology systems of the GAL. The farming network use free natural resources such as solar radiation, atmospheric carbon, nitrogen, biological processes that recycle biomass, nutrients, and water, to increase farmer productivity and output, and mitigate economic shocks and maximise returns. Reconfiguration of livestock systems and reintegrating them to ensure the well-being and health of animals, humans, and to produce healthy, high-quality food, and the perpetual motion of production and consumption, sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products underscores the agricultural techniques of the new world. GAL enables farmers to tap into their inner resources and build a successful agribusiness from scratch using advanced knowledge in indigenous and modern businesses.

## 3 | THE GAL INCUBATOR AND ACCELERATOR

The Gnostic Agritech Limitless agroecology system runs a regular business incubator and accelerator model tempered by sound management and integrated circular economy principles. The scheme recruits the best startups through its flagship training programme in Meta farming. After an intensive three-month curriculum focused on both personal development and new venture creation, mentees are given hands on entrepreneurial experience to contribute to creating a vibrant ecosystem by bringing into the marketplace tailored and tested solutions to existing problems. Only the most passionate, upbeat, fully conscious entrepreneurs proceed to the next stage where they demonstrate the viability of their projects in the business pitch competition after successfully completing the theoretical training of setting up a business and writing business plans. A strict screening programme through the mentorship of the first three months is implemented. Those who progress to the next stage can receive funding and at this stage all ideas that can be dreamed become physical realities as incorporated businesses jointly run by GAL and young entrepreneurs in an agreed upon formular. All impossible ideas are turned to possibilities. 'We help you dream realities' is the mantra of the trainers.

Seed funding is provided after scrutiny, cost benefit analysis and business idea viability and successful prototyping. Facilities in an entrepreneurial focused co-working space, access to university resources (materials, subject matter experts), connections to a large circle of investors and fundraising assistance, and a one-to-one mentoring from a curated list of experts is put at the disposal of entrepreneurs. GAL earns 12% equity at take-off of most projects with further negotiations depending on the size and reach of the invested capital and the depth of the business idea. An engagement with Founders to earn an additional 5% equity based on achieving mutually agreed upon metrics ensures that the best way to help entrepreneurs grow their businesses and become true owners is assured.

Industrial development through modernised, a decentralised, demand driven technological diffusion has been implemented via the Meta Farms Extension Services (MFES). MFES provides research on new inputs and seed varieties for farmer-based organisations and network of farmers. Three country hubs in the Savannah, Forest and Coastal belt covers the extension needs of farmers, providing critical infrastructural investments to strengthen integrated business models along selected value chains for sustainable economic growth.

For the rewards of agriculture to be fully realised, strong commercialisation is required. Commercialisation is the end stage of MFES research which is only in the second year of unfoldment. New techniques in plants and animal husbandry, development of organic based compounds for healthy farming and improved soil culture and technology is being implemented across the network of Meta Farms. MFES has supported the youth with good business plans to farm in blocks of land acquired for out grower schemes that feed into the processing units. Ghana's light manufacturing that targets agro-processing and food import-substitution (specifically, rice, poultry, cassava, sugar, and vegetables), pharmaceuticals, and textiles & garments sector are given new lease of life through the MFES.

The GAL agroecology system and its affiliates such as Nabiya Kapital, Meta Farms, are the seeds for industrial development through agriculture, using agricultural resources and practices as a basis for economic growth and industrialisation. These platforms recognize the importance of the agricultural sector in providing raw materials, employment opportunities, and market links for the industrial sector.

One way to achieve industrial development in Ghana is through value addition and agro processing. This involves transforming agricultural raw materials into finished or semi-finished products with higher value and market demand. Ghana's comparative advantage in maize, rubber, cocoa, hemp cashew among other crops can now be processed into food products, and fibres can be developed into textiles, rubber into tyres and agricultural waste can be converted into biofuels or other useful byproducts. Through the GAL a strong imprint on agribusiness and agricultural entrepreneurship that provides support and incentives for individuals or cooperatives to invest in agricultural-based industries such as food processing, packaging, storage, and distribution has taken root. By focusing on the joint feedback loop of agriculture and industry, the large army of unemployed youth can be absorbed into meaningful employment while adding value to natures gifts.

In addition, technology and innovation employed in GAL agroecology system plays a crucial role in leveraging agriculture for industrial development. The adoption of advanced farming techniques, digital tools, and precision agriculture improves productivity, increase efficiency, and enhance competitiveness in the agricultural sector. This, in turn, contributes to the growth of allied industries and the overall industrial development of Ghana.

Overall, industrial development through agriculture recognizes the potential of the agricultural sector as a catalyst for economic growth and aims to harness its resources and potential to promote industrialization, job creation, and increased value addition in the economy.

## 4 | WATER AS A CONDUIT FOR ACCELERATED AGRICULTURAL AND INDUSTRIAL DEVELOPMENT

The Ghana Irrigation Development Authority (GIDA) has been at the forefront of developing irrigation infrastructure through the exploration of water resources for livelihood options in agriculture at appropriate scales for all communities. Like many public sector driven projects, the management has not been solid. Generally, large-scale irrigation infrastructure has received huge public investments, but the returns have not often been pretty. Furthermore, concerns over negative social impacts have also been raised over large reservoirs as they cover a greater area. These include the displacement of residents in affected communities and lack of compensation for the lands confiscated; an example is the case of the Vea scheme in the Upper East Region (Konings, 1986). Moreover, large-scale irrigation schemes in sub-Saharan Africa have underperformed resulting in lack of further investment into large-scale irrigation infrastructure. Although the Tono, Vea and Dawenya projects are viable, they are severely underfunded and underutilised. The construction of these large-scale projects become another avenue for siphoning large amounts of public resources away from real development. As part of the accelerated agricultural and industrial drive, recent policy has shifted toward small scale dams under the one village one dam programme.

The earth is essentially a water planet. Tiamat has only 30% land cover according to recent conservative scientific estimates. About 30% of all freshwaters in the world is groundwater. Armed with this information and the fact that the major rivers in Ghana are going through intense pollution due to alluvial mining and reckless dumping of waste in major water channels, a rethink of the water infrastructure is critical for transformative agriculture. Ghana's agriculture is still largely rainfed. Developing small scale irrigation schemes and drilling boreholes to support all year-round farming has long been the goal of the GAL Meta Farms.

Appeal of solar powered boreholes and ground water systems, complemented by modern irrigation system and improved methods of ground and surface water harvesting hold the key to agricultural transformation. Water saving techniques and off grid solutions using mini turbines on dams provides the Met Farms of GAL a range of avenues beyond mainstream farming and animal husbandry to aquaculture and fisheries.

In the savannah areas, especially in the north of Ghana, the single rainfall season from April till September deposits on the land a considerable amount of water (up to 40 inches in most places) which mostly washes away and is succeeded by a severe dry season during which crops will not grow and livestock deteriorate through hunger and thirst. With an adequate supply of water, land could support two crops or food every year. Both human beings and livestock would also survive much better if the water were conserved and used evenly throughout the year.

Water conservation and modern irrigation systems which bring relief in every village in the Northern and Upper Regions is a sound policy whose delivery may be well accomplished through carefully thought out private and public sector interventions. At the entry level, small household boreholes provide the ideal groundwater system for farming because it reduces the usage of potable water. Used in place of municipal water, rural and community boreholes provide self-sufficient water source for businesses. Although the quality of borehole water is drinkable after being tested and should not be used for high-quality food products (unless filtered), it works exceptionally well for plant irrigation and other sanitation requirements on home gardens

and farms. Compared to other water systems for farming, the initial cost to install a borehole is inexpensive, but the return on investment and long-term savings it brings to businesses are massive.

The water-based solutions pioneered under the GAL Meta Farms are a response to the urgent need for inexpensive, environmentally sustainable power supply. In rural set ups where the grid is not available this option offers a relief and empowers farmers. Where the grid exists, it remains inefficient, unreliable, and very expensive. Solar powered irrigation offers a leeway. By strategically placing on roof tops and at vantage points, infinite sunshine projects directly onto a solar panel, and the energy from the sun is absorbed by thephotovoltaic cells in the panel. This energy creates electrical charges that move in response to an internal electric field in the cell causing electricity to flow. In the case of borehole water supply, the panels power an electric motor which in turn powers a borehole pump. These hands-on techniques in the Subinso Meta Farm have solved myriads of problems for farmers. The installation of a solar borehole pump ensures that not only those areas that are typically beyond the reach of power lines receive water but that current irrigation, livestock water and potable drinking water systems can be replaced by ones that won't need to rely on electricity. Remote areas often do not have access to clean running water, and solar borehole pumps alleviate the lack of this necessity.

Requiring less maintenance and increased operating costs are an attractive benefit to going off the grid with a solar borehole pump. The sun being an infinite source of energy means that you are not restricted to running times, as they are operational throughout daylight hours. The biggest advantage is that one no longer must dread receiving electricity and water bills.

Some studies in Africa's groundwater potential show that the continent has 20 times more water available as groundwater compared with that available in lakes and rivers (MacDonald et al., 2012). The relative importance of groundwater in staple crop production is between 14-18% of global cereal production and up to 50% or greater of cereal production from irrigated areas (Burke et al., 2012).

## 5 | FINANCING LOCAL AGRICULTURAL AND INDUSTRIAL REVOLUTION IN GHANA

The Meta Farms are private sector driven initiatives with very limited government support. The major funding is derived from the Nabiya Kapital Foundation which owns 30% equity in all the entities that are created and incubated within the GAL scheme. Private shareholders control the remaining shares. In the current set up, AREF Group own 23%, MECC Group controls 15% and 5% is floated for public sector entities. Farmer-based organizations and the youth own and manage the project with support from NVM.

Through crowdfunding it is possible for agriculture project sponsors to directly reach large numbers of individual investors, broadening a project's capital structure and experiment with more creative investment terms and conditions.

In an equity crowdfunding structure, in exchange for an investment, an investor receives an equity interest in the venture funded. The terms and conditions of the equity investment generally vary on a case-by-case basis. Under the Meta Farm system of GAL, investors identify a high yielding, well managed and profitable operation and commit their funds for an agreed period, depending on the project (fish farming, water infrastructure, food processing, animal husbandry, storage etc). GAL takes donations from various sources, especially organisations that share the ethos of transformative agriculture and decentralised production and rural enterprises. Wealthy and high net worth individuals who want to remain anonymous continue to make tax deductible donations that support the various programmes and complements the work of the farming networks.

Gnostic Agritech Limitless uses the aggregator concept where smaller investors participate in promising agriculture ventures of different sizes and in different farm locations. In keeping with the maxim of 'little drops of water make a mighty ocean', the system uses the aggregator scheme to fill an important gap between equity and debt financing which has long been the weakness of traditional investment in agriculture. Typically, it takes time to conclude the lengthy contracts and paperwork involved in raising equity capital from traditional sources. Given that most agriculture is largely rainfed, delays in reaching a deal compromises farmers output and raise the risks of production, which amplifies the risk-return dynamics in agriculture. Limited access to capital at the higher end of the risk spectrum, poses a major challenge to small and medium-sized agriculture companies who need higher risk capital so that they can create cultures of innovation and take healthy risks which can allow them to offer new agriculture solutions, create production efficiencies and significantly build firm value. By pooling smaller funds from different investors, this funding model solves myriads of agriculture related problems driven by antiquated financial system which cannot fully assess the risk of uncollaterlaised farmers. It solves the need for credit record bureaus and existing formal financial systems. By bypassing the constraints and creating new networks, the Gnostic Agrictech Limitless delivers real value in time and space for the farmers and investors.

Concerns over low quality foods and health implications makes this model very appealing. Individual investors and consumers are directly involved in earlier stages of the food production cycle. The fact that all food sector investors are also food consumers creates the possibility of paying investment returns not only through capital but also through food products that the farm has produced. This can help to convert producers and consumers from people who are on opposite sides of the food chain to partners. In keeping with the laws of fair exchange and equal co-creation, the funding model is structured to ensure that capital raised lead to successful ventures that create a stage for long-term and mutually beneficial company-investor relationships.

## 6 | PRELIMINARY EVALUATION OF THE GAL INCUBATOR

Available data from the registrar General's Department of Ghana indicates that about 90% of businesses registered in Ghana are micro, small and medium scale enterprises (MSME). The GAL experiment seeks to boost the MSME sector through unfettered access to finance and markets for women and the youth through Youth Agribusiness Start-Ups (YABSUS). The YABSUS programme of GAL has been in operation for 5 years, starting from early 2018 when land acquisition and preparation begun to the evaluation period of mid-2023. At the time of writing, the infrastructure was still being put together and production of cash crops, vegetables and animal rearing has started in earnest in some of the model farms. Increased presence of the 5 Chief Agricultural Extension Officers injected research and support for high yielding varieties and plant and animal health. The extension education and coaching programme contributed to production increases through demonstrations as well as regular farm visits. Data for the past two seasons of 2022/2023 showed maize production increased by 35%, rice increased by 44%, yam cultivation quadrupled from 20% to 80% and sorghum went up by 38%. The long gestation period for cashew, cocoa, rubber, oil palm, coconut and the mango plantation mean that evaluation can only commence in the next two years when fruiting begins.

A focus on women enterprises is a strong niche area of YABSUS. Agricultural extension officers have provided training in market-oriented extension approaches, new extension models, post-harvest losses. Around 33 women farmer-based organisations have been trained and equipped with funding and tools to enhance the processing of various agricultural commodities such as cassava, cashew, peanuts, sheanuts, sunflower and sesame. As data trickles in during the evaluation period, more research would be needed to quantify the output changes to be juxtaposed with the input injections. Preliminary data indicates that the return on investment has already shown strong positive numbers in just two years.

Through collaboration with the Meta Agricultural College, three laboratories and a modern mechanisation center to support the practical teaching of students is underway in The Pungu Telania Farms, the Afram Plains Demonstration Centre and the Subinso Meta Farm. Each of the college centres have been provided with a 30-seater bus to enhance movement of students to industrial learning centers. Emphasis of the educational curriculum is on agri-business ventures and entrepreneurial courses, as well as the establishment of student-managed farms and student business competitions to expose them to industry practices and equip them to become self-employed after graduation. Some of these students have developed bankable business plans and pitching their ideas for funding consideration from the private sector.

### 6.1 | Evaluation of projects from beneficiary interviews and feedback

#### 6.1.1 | Akiwele Anepaare, 35-year-old rabbit and grasscutter farmer:

I was in the capital city looking for non-existent jobs. When I heard of the opportunities offered by the Meta Farm training, I jumped in. I have always liked animals. When I was a child, I used to rear rabbits. I heard of a training in grasscutter and rabbit rearing. I decided to participate and today I earn far more from the rabbit business than roaming aimlessly in the city trying to eke out a living. I have 770 rabbits and 84 grasscutters in my farm. The demand for my rabbits is immediate, and the profit is very good. Proper training is all that is required to access the benefits talked about in the brochures. I will recommend Meta Farming to everybody at any time. You earn money by simply following your passion.

#### 6.1.2 | Emefa Amenuvenu, 27-year-old Animal feed producer:

Meta Farms Executive threw a business challenge opportunity to us. Through their competitive training programme organised by the Nile Valley Multiversity, we were taken through rigorous training on how to manage our business. Although I have a first degree in Business Administration, I have never been exposed to the science and art of running my own business practically. We were taught by practitioners and successful business owners how to think about transformative agribusiness, access to finance, proper bookkeeping, and the rudiments of human resources. Within a year of going through the programme I have managed to

successfully establish my first processing plant, specialising in animal feed, organic compost using dead plant and waste material and high nutrition sunflower-based food for the animal husbandry industry. I am now at the verge of opening my first major branch in the next village which is about 20 kilometres away from here. When that is complete, I would be employing a total of 35 people in less than two years of operation in these two villages. The youth here are happy to get involved in what I am creating here, and they earn decent incomes. The profit margins of my business are good as I am guaranteed a market by the buyer's group under the Gnostic Agritech Limitless platform.

### 6.1.3 | Hasana Mustapha, 41-year-old farm tools and processing equipment manufacturer:

I took the Meta Farming course organised by the teachers of Nile Valley Multiversity. I was initially not convinced about the whole idea because it promised too much. Having failed twice to launch my business, I was not convinced that such juicy offers were available. For instance, in the call for application and internship, they wrote that participants who did the exercises and took up the disciplines will be able to incorporate and run successful agribusiness in collaboration with the Meta Farmers network. They offer mentorship and are mostly angle investors. The entire six-week training cost a fraction of what one would pay for a four-year degree. They oversaw the training material and prepared the trainees to access funding, at low interest rates. After successfully completing the programme, the trainees are linked up with a mentor to help convert the knowledge into a real business. From the conception to the final establishment of a real entity, the Nile Valley Multiversity professors lead the students and guide them conscientiously. My first set of activities included identifying a problem with which my project can provide a solution. After two weeks I could already see where I wanted to go. There is this issue of lack of appropriate technology in the agricultural value chain. Farmers still use too much manpower to produce food. Most of the food produced go waste due to lack of storage and the prices are not always good when the harvest is good. I thought that if I can use the training to ignite my design and engineering skills, I can provide one bullet to solve several problems. I started experimenting in my head with small scale farm implements for tilling the soil. This resulted in my first prototype of the bullock type plough which is now in an advanced stage of development, able to plough an acre in two hours and adequately prepare the land for sowing instantly. I also played with cashew and tomato processing, and as I imagined the solutions and the relief it will bring, the whole world just opened when one of the instructors who taught us about lateral thinking opened a whole new world to me. I could see incubators, solar devices, and renewal energy systems. The Meta Farm itself is a whole laboratory for experiments. First, I toyed with how to design an incubator that can hatch 300 eggs. Since we don't have a grid on the farm, my next natural problem to solve was electricity. Fortunately, we have abundant sunshine and I have already grasped the lessons of how to develop simple solar devices for home applications. I was successful in using a portable solar system, which uses a device that combines the battery, inverter, and other electronics into a single unit to power my first incubator. The challenge for me is to find a simple way to generate power by tapping the sun directly since the cost of portable solar devices are still high.

I am now moving into the production of spare parts and repair services for small scale factories where we sell machines and devices. All our agro-processing equipment such as the universal milling machine, drilling machines,grinding machines are versatile for shea nut and sunflower processors, corn and cassava processing, and the incubators for hatching all kinds of eggs (guinea fowls, chicken, peafowls, turkey, ostrich). We provide training for human resources capacity building and after sales service support.

Our key constraint now is scaling up the business. We intend to train many artisans to gain technical knowledge that can help them get jobs and spread the technology. Through the Nile Valley Multiversity, we can seek collaboration with research institutes such as the Council for Scientific and Industrial Research and the various institutions of higher learning. Another key challenge to our work is how to integrate the process of fabrication and manufacturing. We have tabled a proposal for support to develop home-grown welding and fabrication workshop that will be equipped with arc and spot-welding sets, hydraulic press, metal sheet rolling machine, tube/pipe bending machine, box and pan folding machine, metal sheet hydraulic swing-beam shears (guillotine), and blacksmith tools. With these we can produce any tool that is needed for agricultural and industrial expansion in Ghana and lead the export of these tools to other parts of Africa where the need is even greater. We seek to become established to serve as magnets for industrial activity and have been equipped to perform a hub for technology innovation, dissemination, and transfer to the informal sector.

## 7 | CONCLUSION

The Gnostic Agritech Limitless agroecology system offers a glimmer of hope for transformative agriculture and industry and decentralised production, distribution, exchange, and consumption within the Meta Farm network. Imbued with professional guidance and training in agro based industries and rural enterprises and backed by researchers and professors at the Nile Valley Multiversity, the scheme empowers rural folk to localize production and returns the forces of nature to the hands of the real power holders. Rural urban migration is checked while increasing incomes through guaranteed prices and markets liberates the energies of farmers to concentrate on the key tasks of developing good agricultural practices that boost production and incomes. The programmes providee business development services such as the identification of business opportunities, business plan preparation, facilitation of access to finance/credit and business diagnostics. A preliminary overview of the GAL scheme indicates a plethora of successes, from the application of indigenous and modern techniques in food production and animal husbandry to the deployment of innovative finance and insurance products to mitigate risk and improve production. Looking ahead, the GAL holds the key to unlocking the enormous agricultural wealth of Ghana through value addition and focussed investment in groundbreaking agribusinesses.

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