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TRANSFORMING SMALL-SCALE FARM ENTREPRENEURSHIP THROUGH INNOVATION: THE CASE OF CROSS LINK

Анотація. *Дослідження зосереджено на важливій ролі інновацій, освіти та технологій у розвитку сільськогосподарського підприємництва серед молоді, особливо в країнах Африки на південь від Сахари. Дослідження висвітлює проблеми та можливості, що виникають на перетині традиційних сільськогосподарських практик і сучасних технологій. Мета дослідження полягає в тому, щоб заповнити прогалину в літературі щодо молодих сільськогосподарських підприємців у Гані, надавши детальне тематичне дослідження, яке могло б стати мотивацією для інших дрібних фермерів-початківців. У статті досліджуються чинники, які сприяли успіху Cross Link Farms, зокрема освіта, мережеве спілкування та наставництво, отримане підприємцем, а також практичне застосування інноваційних технологій, таких як розумні інкубатори та гідропонні системи. Цей приклад демонструє важливість підприємницької освіти, яка прищепила пристрасть студенту стати співзасновником стартапу, що займається підприємництвом на фермі. У документі застосовано підхід дослідження конкретного випадку, дані збиралися за допомогою інтерв'ю. Інтерв'ю було записано та транскрибовано. Дані проаналізовано інтерпретаційно.*

Основні висновки підкреслюють, що інновації та технології в поєднанні з міцною освітньою основою та системою підтримки є життєво важливими для трансформації сільського господарства в Гані та подібних регіонах. Cross Link Farms є моделлю того, як молоді підприємці можуть використовувати ці елементи для стимулювання змін, підвищення продовольчої безпеки та сприяння розвитку сільської місцевості. Отримані результати свідчать про те, що цілеспрямована політика та програми, які сприяють підприємницьким інноваціям у сільському господарстві, є важливими для сталого розвитку в Африці на південь від Сахари. Ґрунтуючись на результатах тематичних досліджень, рекомендації для майбутніх досліджень включають проведення емпіричних досліджень із залученням підприємців у країнах на південь від Сахари, щоб оцінити роль допитливості, стійкості та пристрасті в їхньому підприємницькому шляху.

Ключові слова: *підприємництво, інновації, фермерство, країни на південь від Сахари, технології, освіта*

JEL Classification: O13, O31, O32, I23

Absztrakt. *A tanulmány az innováció, az oktatás és a technológia kritikus szerepére összpontosít a mezőgazdasági vállalkozói készségek fejlesztésében a fiatalok körében, különösen a szubszaharai Afrikában. A tanulmány rávilágít azokra a kihívásokra és lehetőségekre, amelyek a hagyományos mezőgazdasági gyakorlatok és a modern technológiák metszéspontjában adódnak. Ennek a tanulmánynak az a célja, hogy kiegészítse a ghánai fiatal mezőgazdasági vállalkozók szakirodalmát egy olyan részletes esettanulmány bemutatásával, amely motivációként szolgálhat más kistermelők számára. A cikk feltárja azokat a tényezőket, amelyek hozzájárultak a Cross Link Farms sikeréhez, beleértve a vállalkozó oktatását, hálózatépítését és mentorálását, valamint az innovatív technológiák gyakorlati alkalmazását, mint például az intelligens inkubátorok és a hidroponikus rendszerek. Ez az esettanulmány bemutatja a vállalkozói ismeretek oktatásának fontosságát, amely szenvedélyt keltett egy diákban, hogy társalapítóként alapítson egy farmvállalkozást. A dokumentum esettanulmányos megközelítést alkalmaz, az adatgyűjtés interjúk során történt. Az interjút rögzítették és átírták. Az adatokat értelmező módon elemezték. A legfontosabb eredmények azt mutatják, hogy az innováció és a technológia erős oktatási alappal és támogatási rendszerrel párosulva létfontosságúak a ghánai és hasonló régiók mezőgazdaságának átalakulásához. A Cross Link Farms egy példa arra, hogy a fiatal vállalkozók hogyan használhatják ezeket az elemeket a változás előmozdítására, az élelmezésbiztonság javítására, valamint a vidékfejlesztéshez. Az eredmények arra utalnak, hogy a mezőgazdaságban a vállalkozói innovációt előmozdító célzott politikák és programok elengedhetetlenek a szubszaharai Afrika fenntartható fejlődéséhez. Az esettanulmányok eredményei alapján a jövőbeli kutatások számára javasolt empirikus tanulmányok elvégzése a szubszaharai országok vállalkozóinak bevonásával, hogy felmérjék a kíváncsiság, a rugalmasság és a szenvedély szerepét a vállalkozói útjukban.*

Kulcsszavak: *vállalkozói szellem, innováció, farmgazdaság, szubszaharai Afrika, technológia, oktatás.*

Abstract. *The study focuses on the critical role of innovation, education, and technology in fostering agricultural entrepreneurship among youth, particularly in Sub-Saharan Africa. The research highlights the challenges and opportunities encountered in the intersection of traditional agricultural practices and modern technology. The purpose of the research is to bridge the gap in literature regarding young agricultural entrepreneurs in Ghana, providing a detailed case study that could serve as motivation for other aspiring small-scale farmers. The paper investigates the factors that contributed to the success of Cross Link Farms, including the educational background, networking, and mentorship received by the entrepreneur, as well as the practical application of innovative technologies such as smart incubators and hydroponic systems. This case-paper demonstrates the importance of entrepreneurial education that instilled a passion in a student to become the co-founder of a farm entrepreneurship startup. The paper applied a case study approach; data were collected through the usage of interview. The interview was recorded and transcribed. The data were analyzed interpretively. The main conclusions emphasize that innovation and technology, when coupled with a strong educational foundation and support system, are vital in transforming agriculture in Ghana and similar regions. Cross Link Farms serves as a model for how young entrepreneurs can leverage these elements to drive change, enhance food security, and contribute to rural development. The findings suggest that targeted policies and programs that foster entrepreneurial innovation in agriculture are essential for sustainable development in Sub-Saharan Africa. Based on the case-study findings, recommendations for future research include conducting empirical studies involving entrepreneurs in sub-Saharan countries to assess the role of curiosity, resilience and passion in their entrepreneurship journey.*

Key words*: Entrepreneurship, Innovation, Farming, Sub-Saharan, Technology, Education*

Introduction and Problem Description. Small holder agricultural entrepreneurship contributes to job creation and wellbeing of rural livelihood [18]. The Sustainable Development Goal (SDG2) emphasizes that small-scale agriculture is one of the essential factors for sustainable agriculture, food production and hunger alleviation [17]. This paper contributes a case study of a Ghanaian young farmer's journey from conceptualization of small-scale farm to maturation and the factors that enabled the successful establishment of small farm entrepreneurship. Farm entrepreneurship case studies contribute essential insights for motivating rural farm entrepreneurship with the advantages of spurring social capital in rural agricultural and promotion of rural development [16].

In the heart of Ghana's agricultural landscape, where the sunbathes the land in its golden glow and the pulse of rural life beats in harmony, a story of innovation and unwavering determination takes shape. Against this backdrop, we find Cross Link Farms, a venture that aims to not just to transform the land but also the lives of those who depended on it.

Wisdom, a young and curious mind, found himself a chance encounter that would set his path in a new direction. A school project, a modest effort that brought together a group of aspiring agricultural enthusiasts. Their mission: to improve local poultry production at a grassroot level. Driven by a shared ambition, they set out to revolutionize poultry farming. But as often happens, their initial prototype faced challenges, and their hopes waned. One by one, the members of the club moved on to other pursuits, leaving behind unrealized dreams.

However, amidst this setback, Wisdom saw potential in their partially formed idea. He viewed the imperfect prototype not as a failure but as the blueprint for a grand vision. This unassuming invention, a smart incubator, became a symbol of Wisdom's determination. With unwavering courage and a clear vision, Wisdom realized that if he could create an incubator, he could also manage an entire farm. The quiet land would soon teem with life, and technology would blend seamlessly with agriculture to create "Cross Link Farms."

As this journey continues, marked by challenges that tested his resilience, decisions that shaped his future questioned his unyielding commitment to the vision. Yet he remained faithful to his path - to change Ghana's agricultural landscape one automation at a time.

The problem warranting this paper is that whilst several research has been written on farm entrepreneurship in Ghana [1,3,6]; none of these papers have focused on a presentation of the emergence and maturation of young farm entrepreneur to serve as motivation for other aspiring young small-scale farmers. Accordingly, this case paper bridges the gap in existing literature in Ghana farm entrepreneurship as it elevates the challenges and the success factors that a young farm entrepreneur may face along the journey to a successful farm entrepreneur.

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Literature review. Innovation in agriculture is closely embedded in the sustainable development goal (SDG 2), which anchors on "*End hunger, achieve food security and improved nutrition and promote sustainable agriculture*" [17]. The UN Global Goal lays emphasis on the urgency for supporting sustainable agriculture, empowerment for rural small-scale farmers, knowledge and access to relevant financing, increasing the productivity of small-scale farmers and the attendant increase in their income [17]. Accordingly, different aspects of interventions in agriculture are relevant for enhancing food security aspirations of the sustainable development goal [7].

Regarding transformation in agriculture, scholars suggest that innovation in agriculture may require practical application of education through learning, and evaluations through continuous monitoring [7]. They stress that enhancing food security requires development of novel methods and tools, which are enabled by relevant education and technology [7,13]. Innovation and technological application are found to significantly improve small-scale farming productivity. However, relevant education capacitates innovation and technology for new production designs [11]. This is supported by another research conducted in Quebec, which concludes that technological innovation plays a vital impact on agricultural efficiency [5].

Pan et al [15] evaluated the effect of farmers' creative entrepreneurship on the growth of agriculture in China. They applied Panel data from 2015 to 2020, which encompassed 30 provinces (cities and autonomous regions in China) in the study. Distinct effects were found in different regions with varying patterns of grain production and household wealth. In the end, Pan et al (2024) study highlights the central role of integrate farmers' entrepreneurial innovation in agriculture and offers factual proof in favour of the necessity of putting unique, targeted incentive programs in place for rural agricultural entrepreneurship. Innovative entrepreneurship in rural agriculture contributes significantly to transforming rural agricultural productivity, and bolsters rural economic growth [19]. In other strands of research, technological education is found to enhance farmers awareness of innovative techniques and physical assets, which bolsters dramatic increase in the level of farm productivity and efficiency [14]. This is well supported by another research by Gretska [10], which expatiates the important role of technology in boosting the Canadian agriculture production and exports to other countries. In another related research, Deng et al [8] evaluated the effect oof technology on the farm production in Northwestern China, their findings indicate that technological farm inputs and farm machines had a significant relationship with about 45% increase in farm outputs. In addition to farm outputs benefits, technology adoption in farm households contribute significantly in boosting farm income [4].

Other researchers evaluate the factors that affect technology adoption by small farmers. To evaluate the variables impacting the adoption of agricultural technology among smallholder farmers in Ethiopia, Feyisa [9] conducted a meta-analysis based on previous empirical literature. Findings from Feyisa [9] study show that the main factors influencing Ethiopian farmers' adoption of agricultural technology were identified using a random effect model. The results of the random effect model showed

that several variables, including the age of the head of the household, educational attainment, size of the farm, ownership of livestock, availability of credit facilities, access to extension services, cooperative membership, and market proximity, significantly influenced the uptake of agricultural technology.

Research Goal. The main goal of this paper is to shed light on young entrepreneurs' journey in Ghana within the agriculture sector and strategies used to bridge the gap between traditional practices and innovative technology. The paper also seeks to improve the understanding of the impact of entrepreneurship education in triggering an entrepreneurship mindset and passion. The aim is to provide insights into entrepreneurship in Sub-Saharan countries.

Methodology. The paper applies a case study design. It uses the interview method to collect the data for the development of the case narrative. The interview was recorded and transcribed. The collected data were analyzed using qualitative interpretive text analysis.

Results and Discussions. During his undergraduate study, Wisdom joined the Science, Technology, Engineering and Mathematics Educational Project (STEMEP) Club of his university. The club took on the audacious task of wanting to build locally manufactured incubators for poultry farmers in Ghana. As part of the team, Wisdom lent a helping hand, but after the prototype did not meet their expectations, most members of the team deserted it. However, Wisdom continued with the project with the hopes of ensuring that the prototype will be improved upon and perfected into a more functional version. To Wisdom, the idea of having to have chicks from these incubated eggs within days bolstered his interest as an engineering student to create a more functional incubator locally.

For me it was kind of a curiosity - starting your first project from the kind of building a machine able to turn an egg into a chicken within some days. That was interesting!

The technical expertise Wisdom possesses as an electrical engineer makes him an excellent builder and innovator. However, his true fascination lay in the practical application of this knowledge. Creating a chicken from an egg within a matter of days was an exciting and life-changing experience for him. Taking part in this project was not just about solving technical challenges, but also about observing how technology has affected real-life situations.

"That was interesting. For engineering, which was the first kind of life project that we were able to do."

Months later, he met with other students who shared common interests with him - an electrical engineering and a software engineering student - and together, they started building a locally manufactured incubator. After months of trial and difficulty in sourcing materials, the team was able to build a functional incubator that could hatch 352 eggs at a go. However, the dream was not to settle on this feat.

If I can build incubators, it means that I can equally start a poultry farm … To be able to build any device that will be helpful to the farmer, you need to understand the processes a farmer goes through as well.

What started as a curious move slowly developed into a fully-fledged business. Wisdom's motivation extended beyond monetary gain. He emphasized that the primary goal was not to generate money, but to establish enterprises that may affect positive change. Crosslink Farms was birthed to tackle the inadequacy of reliable incubators in Ghana existing for poultry farmers, and eventually increase the capacity of these farmers to meet growing demands for poultry in Ghana. In 2021, it was recorded that the country imported over 600,000 tonnes of frozen chicken [2,12]. This figure shows the crippling effect the importation has on the local industry when it comes to pricing amongst other competitive factors knowing it can barely keep up, which compelled Wisdom and his team to proceed into poultry production beyond the manufacturing of the incubators.

Venture Description. On a 10-acre land in Nalerigu, the capital town of the North-East Region of Ghana, lies Cross Link Farms, an agricultural technology firm and farm. It was built with a single vision in mind - incorporating technology and innovation into agriculture and its related activities and services to assist farmers increase yield and production. Though in operation as a farm facility, Cross Link Farms uses the data gathered from its farm activities to feed its research into farm productivity and yield increment serving as its primary research facility as well as a production hub. Wisdom and two other engineers - software engineer and electrical engineer, graduates of the same university - run Cross Link Farms in Nalerigu and Accra (newly opened location in the south of Ghana).

Unique Positioning. Cross Link Farms, provides the following services:

- **Production of Smart Incubators** - As its maiden product, the company manufactures and produces Smart Incubators for poultry farmers. The materials for this are eco-friendly. Currently, more than five hundred eggs can be incubated by the incubator.
- **Guinea fowl production** (hatching services and animal production) - Noticing the need to hatch eggs for farmers and realizing the knowledge gap that existed especially when it came to temperature control, Cross Link Farms decided to add a hatchery to its services, thus, extending its capacity to aid the farmers while generating revenue from the service provision.
- **Livestock production** (goats and sheep) - Currently, the farm has included the rearing and breeding of goats and sheep in its production. This diversification is a tactical approach to diversify their income flows and reduce the dangers connected to a single-product emphasis.

"We were doing our own thing, and we saw that there was money in it."

- **Hydroponic project**: Cross Link Farms currently is running an Indoor hydroponic project as its next big project after the incubator production - another step towards sustainable agriculture. These technologies allow crops to thrive without the

use of conventional soil, saving water and space. They want to develop and optimize hydroponic systems as they dive more into this technology, making them easier to use and cost-effective for farmers. This is consistent with their objective to bring technology-driven solutions to the agriculture industry.

To summarize Wisdom's motivation to become an entrepreneur, he combines curiosity and technical expertise with a genuine commitment to using technology to solve agricultural problems. Through his relentless pursuit of knowledge and passion for innovation, he has grown his company from an idea to a thriving Agri-tech company.

Impact and Innovation. Though Agriculture has been mentioned various times as the backbone of the country's economy, it must be noted that interventions in terms of technology and innovation are very young. Over the years, farmers and rearers of animal produce and meat have always been faced with multiple challenges in their bid to produce enough to meet growing demands. The role of technology, thus, is imperative in boosting general production and increasing output to a great degree. However, as resources are not as plentiful and available and with the increase in importation of produce locally grown and manufactured, farmers daily are not encouraged to produce more. With Wisdom Mahami's background in engineering and history with farmers and animal farmers, his intervention and decision to both locate the centre of Cross Link Farm's operations in the North as well as close to farmers, speaks to his commitment to ensure the age-old problem receives immediate attention.

We have a connection with the farmers. We speak with them and go to their farms. And we try to see what they really have done. It is always shocking to find out that they are very simple tasks that can be solved with technology.

According to Wisdom, deciding to enter farming and locating Cross Link Farms in Nalerigu has allowed him and his team to understand the needs of the farmers on the ground and research on lasting solutions that will aid them.

We assist farmers with automation in terms of automatic filters, give them technical advice related to how to raise these guinea fowls, and we also provide hatching services to farmers.

Incorporating technology and innovation in tackling challenges faced by these farmers daily, Cross Link Farms not only solves immediate issues, but trains and teaches farmers on how to become better at what they do. In turn, the industry gets more farmers who are educated on newer ways to do things and find means to invest more into agricultural technology to improve quality of yield and increase production as well. This is important to note because especially in the northern parts of Ghana, the high reliance on the weather and nature (traditional systems) continues to make farming a challenging task as Climate Change continues to affect patterns of rainfall and flooding as well as pasture for feeding cattle and livestock. The changing times inspired the need to bridge the gap between tradition and technological innovation.

"So, we speak with them. What are the challenges they face because you see them holding a lot of cattle... That's where we got this idea of a hydroponic system."

For the cattle rearers and livestock farmers, Cross Link Farms has gone beyond incubators to find lasting solutions to issues around pasture for grazing and feed for livestock. As more forest and savanna land are lost to climate change, pastoral livestock farmers will have to continue moving around to find adequate feeding grasslands for their animals, and this, in the short and medium term, as not sustainable means of feeding. With the indoor hydroponic project, Cross Link Farms hopes to produce necessary and important feed crops and plants without the need for soil in a controlled environment that increases yield without worrying about climatic changes.

Integration of Technology. Other areas of technological progress have not been left out by Cross Link and its impressive young team in their bid to make agriculture more productive and technologically inclined. Understanding the essential role innovation and smart technologies are playing in revolutionizing everyday life, precise temperature control in poultry production is one of the ways Cross Link has used advanced technology to address a major challenge in poultry incubation and even brooder houses.

It was a new technology. We had people coming to ask, "Can we bring our eggs for hatching?" ...We saw that this is a business… It was something people needed.

The use of data and research-driven technological innovations in farming activities is the pivot of Cross Link Farms' operations. Technology-driven solutions from precise temperature management to automations lead to increased production and sustainability. Their continual initiatives demonstrate their dedication to maintaining a position at the forefront of innovation in the agriculture industry, where the prospects for the future are limitless.

Factors that have influenced his success.

Educational Foundation

Despite the challenges amongst others, one cannot eliminate the impact of education in the life of a student entrepreneur like Wisdom. The influence of the quality of education received was and is instrumental in whom he has become today as an entrepreneur. From his first year to his last, he was deeply guided by the school in shaping his mindset as an engineer then as an entrepreneur.

We can note that the Science, Technology, Engineering and Mathematics Educational Project (STEMEP) Club played a vital role in him understanding other elements to engineering, especially as his groundbreaking innovation was an offshoot of the club's project - going to prove that the university played a role in creating the environment for him to explore and expand his experimental and experiential learning.

One of the impactful features of his education was his interaction with other entrepreneurs through the school's need to expose its students to the real-world experiences of entrepreneurs.

We had the opportunity of the school bringing entrepreneurs to talk to us about their journeys, their failures…Before we could even start something like this project, we have already heard what people did, how they failed and that has hardened us.

Prepared for most of life's eventualities, entrepreneurs like Wisdom received most of the lessons while in school, even though they will only get the chance to use them later in life. For Wisdom, such an experience helped him build a growth mindset full of grit and resilience. Especially when entering a market that is faced with a sizable number of challenges with both raw materials and other input resources, the ability to move beyond the challenges sets a good entrepreneur aside from the rest.

And all that came from the career talks that we had and the people that came in to talk to us. … Your mind is already open to failure not being an option. Once we have failures, we look at them as opportunities.

Support and Networking

School's Entrepreneurship Hub & Mentorship

Wisdom's university, apart from allowing students to engage with people from industry with their real-world experiences, also created an ecosystem that encouraged students, no matter their discipline, to broaden their horizon and try new things as part of their learning process. For Wisdom and Cross Link Farms, being the part of the first cohort of the university's entrepreneurship hub was important especially in the production of its first incubator.

We do contact people through the hub. We are still collaborating with them, so they share with us, and we get to meet people.

From the mentorship, guidance and support received from the hub and the university community in general, Wisdom could go ahead to successfully complete his project, and through that birth what is now Cross Link Farms. Through the university's assistance, he was able to gain the right mentors who laid foundational tools important for Wisdom to see lines of opportunity beyond his field of electrical and electronic engineering.

Networking

I have had interactions. My colleagues are also entrepreneurs… There is that kind of push, we all pray for all of us to succeed in whatever we are doing… We do check on the progress of one another with ongoing projects…. The school connected them.

From this we understand the need for peer networking especially amongst young entrepreneurs and its impact in their lives. Such networks and connections enable ideas and necessary opportunities to be shared amongst the students. In such a network and group, Wisdom sees everyone else as a potential collaborator or partner, and not a competitor, hence fostering healthy relationships that promote individual growth and development. The ethos of helping one another went beyond the classroom and produced an innovative network that cut across institutional boundaries. Wisdom's experiences highlight the critical role academic communities play in encouraging cooperation and accelerating entrepreneurial accomplishments.

The commitment of the university to cultivate an innovation ecosystem fostered these linkages, propelling Wisdom from a young entrepreneur to a leader pushing dramatic change in Ghana's agriculture industry is remarkable. They give access to vital resources, mentorship, and opportunities in addition to the sharing of ideas, which is necessary for inspiration, collaboration, and growth.

Decision making. In making most of the business decisions for Cross Link Farms, Wisdom relied on his cross functional team to get things done. As they had just launched their successful incubator, entering business came to them as an extended opportunity.

"We saw that people wanted to hatch their eggs. It was something people needed. And we saw that that was a venture that could make us money."

The team had already decided to put their incubator into use by installing it on its farm and hatching their own eggs. In doing so, they discovered an opportunity in doing the same for farmers who could not afford to buy the incubator, thus, extending a service to other farmers while using the opportunity to understand the industry's climate and conditions. The increased demand for hatching services and brooding systems opened the gateway for Cross Link Farms to open its doors to service provision especially in a region that needed it the most, hence, its success as a business.

Cross-functional Team

"I am more or less a technical person. I did the body of the incubators; I ran the farm day-to-day activities. And the second guy, his interest is more into business and stock… He is more business minded. He knows what is happening, what are the ways we can make money… He puts aside our documentation, our expenses, and registrations. He is our software engineer."

It is evident that for many young businesses, the cross-functional nature of its workers is a vital element especially when it is about regularizing its revenue stream and balancing out the production costs. Wisdom's team has all of them wearing multiple hats yet in ways that they do not counter but complement one another's efforts in growing the business.

The innovative thinking of the team extended to their approach to company diversification. They ventured into goat and sheep production after recognizing the opportunity to increase their agricultural activities and reach. This strategy shift enabled them to diversify their revenue streams while mitigating the risks associated with an exclusive emphasis on guinea fowl farming. Their capacity to adapt and grow their activities exhibited a foresight in agricultural entrepreneurship.

Overcoming Challenges

Like for any other entrepreneur, beginning a business and entering an industry that has existed years before presents a buffet of challenges and bottlenecks. For Wisdom, though resilient and strong-willed, he faced multiple challenges in establishing Cross Link Farms.

Expensive Components

Starting from the beginning, in making the groundbreaking innovation - the incubator, he had a tough time trying to get most of the relevant materials to build it.

The cost involved in building these machines are because of some of the controllers we used to build being imported.

Not having all the components locally sourced poses a challenge as well to the future of bulk production, and whether the final price of the incubators is affordable for farmers. For Wisdom, who sought long-term solutions rather than just revenue from production and sales, this threatened his vision for establishing Cross Link farms and succeeding at making an importable machine right here in Ghana.

Erratic Power supply

Further, the energy and power situation in Ghana has always been at the center of affairs whenever it comes to manufacturing and production. Everything runs on electrical power, but should that power source is not dependable, delivery of hatchery services, for example, will be unreliable and be underlined by hundreds of thousands of financial losses.

“The power system is quite unstable… when we started, you can put about 1000 X 9-meter [incubator], then a few days to hatch, you have a black out that can take a couple of days… [and] would destroy our eggs.”

For Wisdom, his team and the farmers, this challenge then defeats the purpose of agricultural technology implementation since losses that could be made without the advent of technology could also be made on a larger scale should there be a disparity in the supply of electricity to power the products and innovations.

Bridging Traditional and Modern Technology

Also, one important reason for Wisdom deciding to locate the farm where it was (back home) was to allow farmers to learn innovative technologies and improve their farming practices.

People are very reluctant to adapt to these technologies… They were used to their mother hens hatching their eggs.

Breaking the barrier of traditional methods through education and training is quite a daunting task as many farmers stick to age-old methods, even though yields may be lower. With others being superstitious about their farming activities and practices, Wisdom faces the hurdle of being innovative about teaching and demonstration to allow these farmers understand the need to automate their practices to make their production more sustainable.

Mitigating Challenges

To overcome and mitigate these challenges, Wisdom and his team adopted an aggressive and tactical method to ensure they addressed the problems at its core.

ECG to Solar

We are now running on solar systems because the power supply is so unpredictable… The only stable power is solar. We went for solar for our incubators, and that solved our major issues.

Transitioning from the reliance on the national power grid to solar energy was an investment in the right direction for Wisdom and his team. The farm could not afford running losses due to erratic power supply while it was in a region with high records of sunshine in the country. This new power supply ensured that production still runs whether the main lines have power or not. With this, Cross Link Farms can hatch more eggs and power its heating systems as well emphasizing its ability to quickly adapt to structural challenges.

Cost-effective production

Fueled by the desire to cause generational changes, Wisdom and his team have started researching ways to make the building and production of the indications and the machines they create more cost-effective and lower for many indigenous farmers or farming cooperatives to be able to purchase and own.

Conclusion and Prospects for further Research. Wisdom and his Cross Link Farms team understand the necessity of broadening their product and service offerings to be at the heart of agricultural innovation. Aside from their present concentration on smart incubators, hydroponic systems, and animal production, they plan to develop and improve these solutions to meet a larger range of agricultural demands.

"We are researching and trying to build projects that will boost this sector up."

That notwithstanding, the objective of Cross Link Farms to broaden its product and service offerings and their devotion to improving current products and services demonstrates their commitment to remaining at the forefront of technology-driven agriculture.

Through these, Cross Link Farms has already proven its ability to develop both inside Ghana and across Africa. Their forward-thinking approach to Agri-tech and effective incorporation of technology into farming operations positions them for wider impact. Understanding the impact made so far by Cross Link Farms in agriculture in Ghana, especially in the northern sector of the country, the future gains and impact areas are endless for the firm. However, to do so, Wisdom and his team at Cross Link Farms must take important steps, measures, and strategies to reach these desired goals and markets.

In understanding the need for growth and expansion especially into new markets and regions, which is crucial for Cross Link Farms' success and sustainable future, how can Wisdom leverage on partnerships and collaborations to ensure the solutions provided by the company are embraced by the farmers? How can Cross Link Farms facilitate training and capacity building to ensure that more farmers can effectively use their solutions? In which ways can such partnerships and collaborations aid in distribution, brand awareness, and even procurement of necessary components to build and create more machinery?

Further, as Cross Link Farms expands to scale, there is an understanding that different regions may require different unique solutions with regards to agriculture. How should Wisdom and his team position the firm to be able to adjust and adapt to these multivariate needs in different areas, especially as a small team that will grow into a bigger one? In moving to these new pilot communities or regions and areas, which strategies can be employed to ensure that the firm overcomes infrastructural challenges, especially in remote regions with limited power supply and access to the internet?

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