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Technologies for African
Agricultural Transformation



Agricultural Transformation through WHEAT:


An Outcome Evaluation of TAAT Wheat Compact's Interventions in Sudan

Technologies for African Agricultural Transformation (TAAT)



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TAAT MEL Working Document No. 005

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This working paper has been prepared as a deliverable for the Monitoring and Evaluation Unit of the TAAT program and has not been peer-reviewed. Any opinions stated herein are those of the author (s) and do not necessarily reflect the points of view of the TAAT programme.

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Background

1. Overview of the Technologies for African Agricultural Transformation (TAAT)

The Technologies for African Agricultural Transformation (TAAT), launched in 2018, is an initiative under the “Feed Africa’s Strategy, 2016–2025” of the African Development Bank. It is structured around nine commodities of importance to the African region. This includes maize, rice, wheat, high-iron beans, cassava, orange-fleshed sweet potato, sorghum/millet, small livestock, and aquaculture. The production-induced technologies included soil fertility management, water management, training/capacity development, policy support, youth in agribusiness and response to the armyworm.

The intervention of TAAT was in conjunction with National and International Research networks to deploy proven agricultural technologies and train value chain actors in Good Agricultural Practices. Enhanced diversification and commercialisation through access to the market was also made possible by collaborations between government, private sector players, Non-Governmental Organizations, Community Based Associations (CBA), and individual actors (farmers, input suppliers, processors, fabricators, financial service providers etc.). The broad scope of stakeholder involvement is expected to provide an avenue for the sustainability of TAAT interventions after completion. The interventions also included a series of enabler systems to

provide a conducive environment for adopting and scaling introduced technologies.

The implementation of TAAT was coordinated by the International Institute of Tropical Agriculture (IITA) in partnership with other research institutions at regional and international levels. They include The African Agricultural Technology Foundation (AATF), AfricaRice Centre, the Alliance of Bioversity International and CIAT, the Centro Internacional de la Papa (CIP), the Forum for Agricultural Research in Africa (FARA), the International Centre for Agricultural Research in the Dry Areas (ICARDA), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Fertiliser Development Corporation (IFDC), the International Institute of Tropical Agriculture (IITA), the International Livestock Research Institute (ILRI), the International Water Management Institute (IWMI), and the WorldFish Centre.

The programme works through an integrated intervention of 15 Compacts, comprising nine “Commodity Compacts” and “Enabler Compacts”. There are six (6) enabler compacts within TAAT to support the Commodity Compacts. These provide a conducive environment and specialist services for the sustainable attainment of programme objectives. The “enabler compacts” are soil fertility management, water management, capacity development, policy support, attracting African youth in agribusiness and fall armyworm response.



Figure 1. TAAT footprint in Phase I

2. The TAAT Wheat Compact’s deployment approach

The main plan of TAAT is to deploy productivity-enhancing technologies to transform Africa’s agricultural landscape. These technologies span improved varieties and pest/disease management to adaptable machinery. Support in the technological deployment was integrated with Training and Capacity building to aid utilisation and domestication across the value chains. The Forum for Agricultural Research in Africa (FARA) coordinates the enabler Compact for Capacity Development and Technology Outreach (CDTO), complementing the commodity compacts.

There has been a visible improvement in the production landscape with the adoption of some of the technologies. Particular attention is given to the success of deploying drought-resistant maize, heat-resistant wheat,

and treatments against pests like fall armyworm, which have been devastating crops across the continent.

In the TAAT Wheat Compact, millions of smallholder farmers in Ethiopia, Sudan, and other countries where the project is being carried out now have access to quality seeds of climate-smart, heat-tolerant wheat varieties for wheat production. In Sudan alone, about 12 heat-tolerant, rust-resistant and high grain yield and grain quality wheat varieties were deployed, with farmers accessing up to 93,304 tons. This

was made possible through the TAAT Wheat Compact’s technology deployment model, which comprised bundled Good Agricultural Practices (GAPs) as one of the associated technologies needed to get the full benefit of the leading technology, including land preparation, planting, fertiliser application, amount and frequency of irrigation application, weed control, disease and pest control, harvesting and post-harvest management.

3. TAAT Wheat Compact: The Sudan Context

Wheat is one of the most important food crops grown in Sudan. The country’s increasing population and changing dietary preferences have contributed to the growing demand for wheat. The potential for wheat to be used for import substitution can only be harnessed if the local production is improved to meet the local demand in Sudan. However, efforts to boost the local production are limited by various factors, including heat stress experienced in sub-Saharan Africa. This brought about the





introduction of TAAT intervention in Sudan to increase the total production by deploying proven technologies such as heat. The potential for wheat to be used for import substitution can only be harnessed if the local production is improved to meet the local demand in Sudan.

Inroads into enhancing the productivity of Sudan's wheat sector started in the 2012 season with the African Development Bank's Support to Agricultural Research for Development of Strategic Crops (SARD-SC) wheat project. This was followed by the 2018 launch of the Technologies for African Agriculture Transformation (TAAT) programme, which is building on collaboration with SARD-SC to change the wheat production landscape significantly.

The TAAT wheat compact intervention began in Sudan in the 2017/2018 wheat season as part of the African Development Bank's TAAT programme, across Africa, intending to deliver yield-enhancing technologies to make Sudan

self-sufficient in wheat production. The goal of the TAAT Wheat Compact in Sudan was to raise the production and productivity of wheat through large-scale deployment of heat-tolerant wheat varieties with management packages for achieving wheat self-sufficiency by 2025. This was to be achieved by introducing and scaling up high-impact, proven technologies that will raise farm productivity, mitigate risks and enhance diversification and value addition by processing.

TAAT employed various approaches to disseminate the new technologies in Sudan. The TAAT intervention approach was based on the Innovation Platform (IP) model to drive the strategic and operational scaling up of the proven technologies and enhance market access for inputs and outputs. With the IP framework, stakeholder inclusion and mutual accountability were made possible for developing sustainable solutions along the wheat value chain. Within the innovative platform, farmers were physically trained, and activities were monitored by hosting field days,

training workshops, farmer field schools, and technical symposia. Indirect beneficiaries were also reached through ICT-based technology, including formal and social media, to create awareness and share training information. Farmers were trained on different wheat production technological options, including raised bed technologies to address the problem of heat, nutrients, water and pest management.

TAAT trained farmers and other stakeholders along the wheat value chain on adopting climate-smart, heat-tolerant wheat technologies. This was done through the hosting of training workshops across the country. More than 170,000 people were trained in wheat production through different approaches, including Good Agricultural Practices (GAPs), which is one of the associated technologies needed to achieve optimal productivity of the deployed climate-smart seed. The GAPs include land preparation, planting, fertiliser application, frequency of irrigation application, weed control, disease and pest control, harvesting and post-harvest management. This was done in a way to ensure further inclusiveness, where farmers can have access to various stakeholders in the value chain. Additionally, eight (8) Innovation Platforms were established. Women and youths were regularly involved in wheat production, farm machinery maintenance services, and value-addition methods in all IP sites in Sudan.

In Sudan, deployment states and corresponding Innovation Platform (IP) sites were (1) Gezira State (Basatna, Eltahameed and Elmattouri IP sites), (2) Northern State, (North Dongola IP site), (3) Kassala State-New Halfa (Sheikh Omer and Butana IP sites), (4) River Nile state (Manasir IP), and (5) White Nile State (White Nile IP site).

4. Operationalisation of the TAAT Wheat Compact in Sudan using Monitoring and Evaluation lens

The Wheat Compact is led by the International Center for Agricultural Research in the Dry Areas (ICARDA) with activities in seven countries, including the East African Highlands, Southern Africa Plateau and the Sahel.

Through experiential learning and sharing of best institutional practices with the active involvement of the NARES partners and IP actors, the data and information generated and data quality were assessed by the Compact



Coordination Unit for validation. This plan served as the overarching framework to generate and analyse data and process information, to identify key strengths and weaknesses in technical and administrative activities and to develop measures to increase the efficiency and effectiveness of the programme. The programme had a clear focus on scaling out proven improved wheat varieties and associated integrated crop management practices, which resulted in increased production and productivity (in both rainfed and irrigated production systems), ensured food and nutritional security and increased market opportunities for producers, job opportunities and employment for the youth and women and ultimately achieve wheat self-sufficiency.

Through literature review, the Theory of Change of the TAAT Wheat Compact in Sudan was reconstructed to understand how the claimed outcomes happened, who supported this effort, what contributed to the change(s) observed, and to understand what lessons were learnt and take corrective measures (Stein and Valters, 2012).

5. Partnership arrangement

One of NARS's responsibilities is activating and coordinating all stakeholders and value chain actors involved in scaling up activities. Other tasks include outreach, advocacy, and awareness-raising campaigns, facilitating and supporting scaling up and training activities

The Wheat Compact Theory of change in Sudan

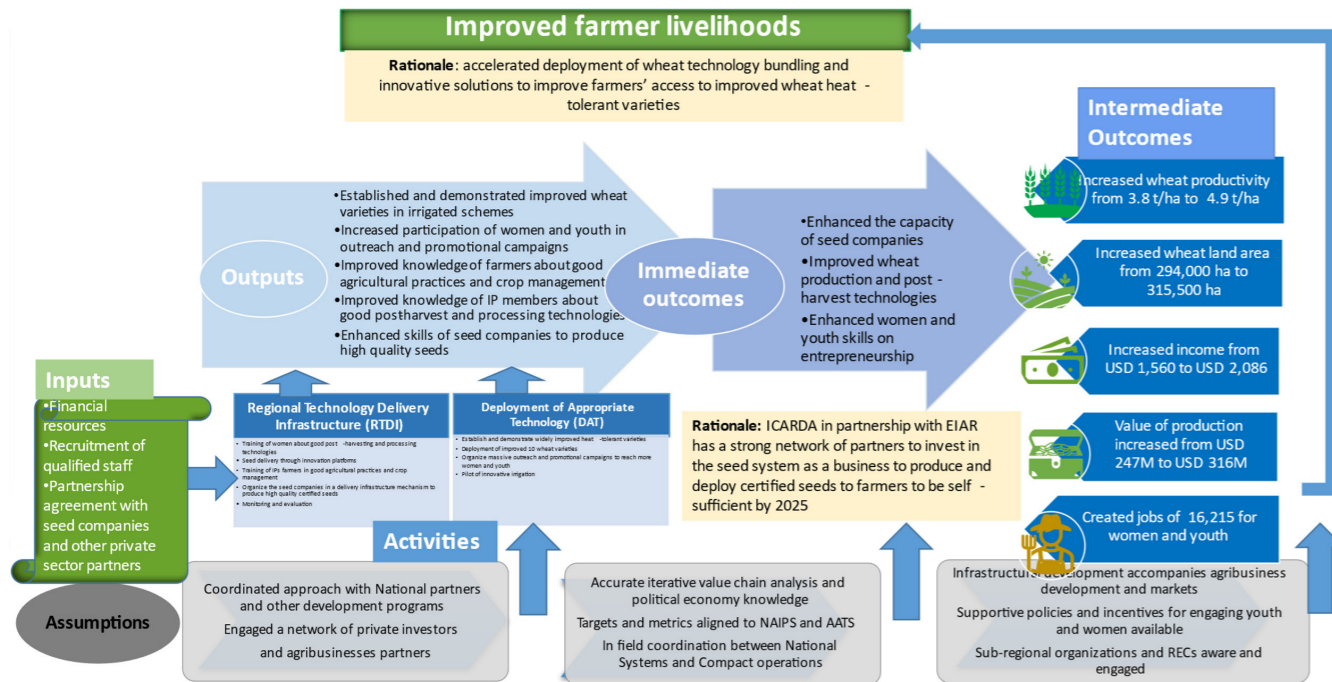


Figure 2. Theory of Change for TAAT Wheat Compact in Sudan

at the project IP sites, and promoting wheat technology toolkits to draw in private sector investment in wheat production, processing, and marketing. Among them is Sudan's Agricultural Research Corporation (ARC). When implementing various activities with farmers, NARS leads the demonstration and offers technical assistance and support to farmers and local agricultural or extension offices. Early generation seed (EGS) produced by NARS will be available to cooperatives, private or public seed companies, and farmer seed producers at IP sites. These entities will then produce and market the seed in response to farmer demand. In an effort to create employment opportunities locally, efforts are made to connect farmers with markets through partnerships with agro-processors in the area or to involve women and youth in the value addition of wheat.

The smooth implementation of project activities across the target countries has been made possible by the strong collaboration and dedication of NARES and wheat value chain actors, including farmers, extension officers, inputs providers, seed producers, financial institutions,

agro-processors, NGOs, and policymakers. The TAAT Wheat Compact is actively attempting to transform the current strategic partnership between the parties involved in wheat production, processing, and marketing into an alliance.

In the wheat value chain, development partners like public or private seed companies, seed producer cooperatives or associations, agro-processors, sector associations (farmer associations, millers associations), and policymakers were actively engaged by NARS partners at a strategic level. At the national level, they acted as information brokers and advocates for the wheat sector's transformation by utilising public and private funding. The NARS partners participated in steering and technical committees that developed and implemented plans for target nations to be self-sufficient in wheat.

• **Breeder and pre-basic seeds:** ARC, Sudan

• **Basic (Foundation) and certified seeds:** Arab Sudanese Seed Company (ASSCO), Nile Sun Enterprise, Makeen Seed Production Co., Rajhi for Agric. Services, Mahgoob and Sons Co, Harvest Company, DIAC, Amtar Company, Social Security Agricultural Investment Company

• **Financial institutions:** Bank of Sudan, ABS Micro-finance Institutions, Agricultural Bank of Sudan (ABS), CTC, MS, Farmers' Commercial Bank,

• **Processors/millers:** SEGA, SEEN, WHEATA, SGAF

• **Government Agencies:** The Ministry of Agriculture; policymakers oversee extension services and awareness creation.

• **Agrodealers:** Providers of fertilisers and agrochemicals: Syngenta are.

Technologies deployed	Location where the technology is deployed		Associated technologies	Partners involved in the deployment of the technology	
	Country	Deployment site		Partners	Role
Heat-tolerant and high-yielding wheat varieties, including Goumria, Zakia, Imam, Elnielain	Sudan	_ Gezira state (Basatna, Wad Elbur and Mukashfi IP sites), _ Northern State, (North Dongola IP site), _ River Nile state (Manasir IP), _ New Halfa state (Sheikh Omer IP site)	Good Agricultural Practices (GAPs) including land preparation, planting, fertilizer application, amount and frequency of irrigation application, weed control, disease and pest control, harvesting and post harvest management	Arab Sudanese Seed Company (ASSCO), Nile Sun Enterprise, Makeen Seed Production Co., Rajhi for Agric. Services, Mahgoob and Sons Co	Produce foundation and certified seeds
				ARC, Sudan	Produce breeder and pre-basic seeds
				Agricultural Bank of Sudan (ABS), CTC, MS, Farmers' Commercial Bank, Syngenta	Fertilizer and agro-chemical providers
				Ministry of Agriculture policy makers	Extension services and awareness creation
				SEGA, SEEN, WHEATA, SGAF,	Processors/millers
				Bank of Sudan, ABS Micro-finance Institutions	Financial institutions

Table 1. Stakeholders Mapping and Analysis

6. Findings of the review

This section presents the findings of the literature review on the operationalisation of the TAAT Wheat Compact in Sudan. It highlights the results reported as outputs and outcomes of the Wheat Compact activities. The findings intend to demonstrate the implementation processes used to deploy TAAT Wheat technologies and the partnerships and delivery infrastructure used to supply breeder and foundation seeds to in-field partners who produce and deliver certified seeds to farmers for production. The findings intend to capture and understand the deployment of TAAT Wheat Compact activities through TAAT Wheat Compact technology toolkits, outputs and outcomes realised, and lessons learned to inform the Compact where corrective measures are needed.



6.1. Activities

TAAT Wheat Compact's inputs were technology and financial support. The technology was the heat-tolerant and rust-resistant wheat varieties deployed to the innovation platforms at different locations. The technology was supported by the introduction of accepted practices in a compendium of agroecological context toolkits specific to the country. Wheat technology toolkit was assembled with economic feasibility data, and technology awareness was conducted.

In Sudan, the farmers (producer associations, cooperatives), the wheat-producing schemes (e.g., Gezira Scheme), the seed producers, input suppliers, financial institutions (microfinance, the Agricultural Bank of Sudan (ABS)) and the agroindustry (flour millers) and the Ministry of Agriculture and Natural Resources (and its affiliated departments such as ARC) all have a significant and integrated role in the wheat sector.

The ICARDA-led wheat compact has collaborated with National Research Agencies and other partners to release heat-tolerant and rust-resistant wheat varieties within the Sudanese wheat production sector.

- **Training and Capacity Building:** Youth and women's groups were empowered within the IP sites by engaging in various TAAT wheat-based innovative agri-businesses in wheat and seed production, value addition, local manufacturing, farm machinery maintenance services, and service provisions along the value chain. at the Basatna, Wad Elbur and Mukashfi innovation platform (IP) sites.

- **An innovative ICT-based method:** This was introduced to disseminate wheat technologies widely among all wheat producers. A total of 10 drama-based episodes were produced and broadcast via different media, including YouTube, TV, public transportation buses and trains, WhatsApp, Facebook, etc.

- **Hands-on training:** The capacity of farmers, youth and women groups and other stakeholders was strengthened by providing hands-on training on good agronomic practice (GAP), post-harvest handling, entrepreneurship skills and product value addition. The hands-on training at farmer field school and proper application of the recommended packages were the keys to their success.

- **Technology scale-up:** TAAT wheat scale-up and dissemination activities were implemented and promoted, including youth and women in leadership positions and as beneficiaries at the representative project-established IP sites.

- **Raised-bed technology:** This was popularised in selected IP sites and promoted to farmers and stakeholders. Collaborative operations were maintained between TAAT Wheat Compact and various enablers for efficient common stakeholders' approach and combined technology toolkits.

- **Private seed companies:** (Nile Sun Enterprise, Makeen Seed Production Co., and Al Daman) played key roles in bulking large quantities of certified seed commensurate with wheat area expansion, contributing to wheat production in the country.

- **Pilot of mechanised irrigation:** (Raised bed irrigation) for wheat based on local technology that could be scaled.



• **Community collaborations:** through the IPs to ensure stakeholder inclusion.

6.2. Seed Production and Delivery

The TAAT Wheat Compact embarked on an ambitious plan of bulking wheat seed to ensure quality seed availability, access and use. This led to the dissemination and adoption of heat-tolerant improved wheat varieties. The TAAT Wheat Compact, in collaboration with ARC, supported early-generation seed production by NARS and certified seed production in partnership with private seed companies and quality-declared seed with farmer-based seed producers (communities, associations) at IP sites. In total, 93,034 tons of wheat seed were produced, comprising 4,184 early-generation seeds, 88,500 tons of certified seed and 620 tons of quality declared seed. This can be estimated to cover about 930,034 ha (@0.1 tons/ha), reaching the same number of beneficiary smallholder farmers. About 12 private seed companies and eight farmer-based community seed producers at eight IP sites were involved in wheat seed production and distribution. The seed multiplication and supply of newly released and demand-driven heat-tolerant wheat varieties was carried out through the engagement of nine private and public seed

companies in producing and delivering essential and certified seeds.

6.3 Desired Outcome for TAAT Wheat Compact in Sudan

TAAT's work has been a critical and defining moment in the lives of 39,000 farmers who have directly benefitted from the program through the provision of seed, technology promotion field days and training. Similarly, farmers like Ahmed along the wheat value chain – 44% youth and women – at innovation platform sites have been trained in wheat grain and seed production, value addition, and innovation. In concrete terms, the compact went to work on enhancing productivity, farmers' income, job creation, and value addition leading to wheat self-sufficiency before or by 2025. These outcomes were to be achieved by (i) Creating the enabling environment, (ii) Delivery of technology infrastructure at a regional level, (iii) Deployment of technology, and (iv) Effective project management and coordination.

The desired outcomes of the TAAT Wheat Compact intervention hinged on enhancing productivity, farmers' income, job creation, and value addition,

all leading to wheat self-sufficiency before or by 2025.

• **Increased annual income per capita for households:** Farmers per household income from wheat production reached US\$ 2,086 compared to the baseline of US\$ 1,560. Based on the average increase in productivity, the participating farmers' income was estimated to be increased by about 80% per cent.

• **Productivity in intervention sites:** Through the TAAT-Wheat Compact intervention, the estimated average productivity of irrigated wheat is 4.9 tons per hectare.¹ In 2017/18, the total wheat area was 201,000 ha. By 2018/19, wheat was cultivated in a total area of 294,000 ha and at an average productivity level of 3.1 tons per hectare. In the 2019/2020 crop season, an area of 315,500 ha was harvested with a productivity of 3.8 tons per hectare. Through the TAAT-Water Enabler Compact intervention,

wheat water productivity reached 4.90 t/ha.

• **Production in Sudan:** The total wheat produced in 2017/18 was 574,000 tons. By 2018/19, wheat production reached 900,000 tons of grain, a self-sufficiency of 45%. In the 2019/20 crop season, wheat production was 1.15 million tons. This was the highest production level ever in Sudan's wheat production history, with a self-sufficiency ratio of almost 50%²

• **Value of production:** From the total wheat area of 201,000 ha in 2017/18, 294,000 ha in 2018/19, and 315,000 ha in 2019/20, about 574,000 MT, 900,000MT and 1.15M MT, respectively, of wheat grains were produced. With conservative estimates of wheat grain price of US\$250 per ton, the total value of wheat produced in Sudan was USD 143,500,000 in 2017/18, dramatically increasing to USD 225,000,000 in 2018/19 and USD 287,500,000 in 2019/20.



¹ TAAT (2021). *Wheat Internal Completion Report. Technologies for African Agricultural Transformation (TAAT) (2018 -2021).*

² ICARDA (2020). *Bumper Harvests and Record Wheat Production Propelling Sudan Towards Wheat Self-sufficiency.* [ICARDA_Sudans-bumper-harvest_FINAL-high-resolution.pdf \(taat-africa.org\)](https://www.taat-africa.org/ICARDA_Sudans-bumper-harvest_FINAL-high-resolution.pdf)

- **Employment created:** The wheat compact created additional job opportunities for farmers, youth and women in wheat grain production, seed production, value addition and allied services (machine rentals, services). Overall, for the TAAT programme, about 113,505 additional jobs were created, of which 44% were youth and women, which is higher than the actual target of 45,000 jobs. This represents about a 252% increase. 982 entrepreneurs were created, of which 28.5% were female. In Sudan, since the start of the TAAT wheat compact in 2018, about 76,000 (42% youth and women) additional jobs have also been created in wheat farming and support services.

6.4 Beneficiaries reached

In Sudan, about 39,000 beneficiaries (42% youth and women) were directly reached through project activities, plus tens of thousands of more people through access to certified seeds of improved heat-tolerant varieties, field days, travelling workshops, word of mouth, etc. Moreover, through an innovative ICT-based technology episode, more than 3,240,000 views have been recorded through the YouTube channel, accessing online video training about 28 interviews and programs broadcasted on national TVs and radios reached an estimated 170,000 people. The capacity of more than 3010 farmers, of which 44% were women and youth and other stakeholders, was strengthened through the provision of focused, hands-on training on good agronomic practice (GAP), post-harvest handling, entrepreneurship skills and product value addition.

5.5 Success factors of wheat production in Sudan by the TAAT Wheat Compact interventions

The success factors cover the entire value chain and its actors, and government support is key at all stages through policies, extension and market facilitation:

- A recognised high domestic demand or national and regional market
- Supporting innovations for the selected technology (e.g., irrigation or post-harvest technologies)
- Private seed companies involvement in

seed production and distribution,

- Active role of millers,
- **The hands-on training:** At the TAAT-organised farmer field school and proper application of the recommended packages were the keys to their success.
- The establishment of 6 Innovation Platform sites.
- **Strong involvement of in-country partners:** The government through policies and actions, and the private sector as a key partner for scaling.

7. Lessons Learned and Challenges

The TAAT Wheat Compact has so far shown remarkable results. Not just in the increased yields, production areas and seed multiplications, but perhaps, more importantly, there is clear evidence that with the proper coordination and integration, stakeholders from a wide range of interested parties. The following lessons/takeaways contributed to the success.

1. Ensure area expansion for wheat with adequate facilities for irrigation schemes (rehabilitation, cleaning, etc.) and improved irrigation management to reduce the amount of water used by a tonne of wheat produced.
2. Increase the volume of wheat seed delivery by incentivising private seed companies through assured markets and access to capital.
3. Ensure the production of better grain quality by introducing a grain grading system and premium pricing.
4. Improve logistics in aggregation, storage and transportation by cooperatives and producer associations.
5. Facilitate capital and credits for farmers and value chain actors financed by the agricultural, rural microfinance and commercial banks.
6. Create forward and backward linkage in the wheat value chain, introducing contract farming involving farmers' cooperatives/associations, seed producers, and flour millers.
7. Ensure system sustainability by introducing legume crops in a wheat-based cropping system to avoid wheat monocropping.

8. Conclusion and Way Forward

The TAAT Wheat Compact was successful in Sudan terms of the Innovation Platform approach used, which allowed technology to be context-built. The effects were seen in massive improvements in the production of wheat and the potential for self-sufficiency in production. Subsequent interventions, however, may need to consider the following:

- **Technology and innovation deployment:** Technologies or seeds alone will not lead to large-scale adoption and crop yield increases. More focus should be placed on market access and access to finance. Without these, efforts to scale technologies will underperform or fail.
- **Leveraging resources on country programmes:** The role of the Clearinghouse in coordinating TAAT contribution to project design and implementation was taken up in the second half of the project, which has been proven efficient and should be intensified in TAAT-2.
- **Capacity development and outreach programmes:** More innovative scaling approaches must be targeted to reach a wider population, such as the development of distance learning modules and programs for extension agents and farmers, phone Apps targeting farmers, and the involvement of the private sector.
- **Monitoring, Evaluation and Learning:** MEL must be defined before the start of the project and sufficient resources must be allocated on time to monitor the programme's impact at country levels.

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