European Commission

N°28
OCTOBER 2020

VCA4D
VALUE CHAIN ANALYSIS FOR DEVELOPMENT

Sorghum value chain analysis in Ghana

Value chain analyses assist in informing policy dialogue and investment operations. They help the understanding of how agricultural development fits within market dynamics. They permit an assessment of the value chains' impact on smallholders, businesses, society and environment.

The European Commission has developed a standardised methodological framework for analysis (https://europa.eu/capacity4dev/value-chain-analysis-for-development-vca4d-/wiki/1-vca4d-methodology). It aims to understand to what extent the value chain allows for inclusive growth and whether it is both socially and environmentally sustainable.

The value chain context

Sorghum in Ghana is important for both food security and as a source of income for households. It is mainly grown by smallholder farmers (SHF), the majority of whom commit less than 2 ha of their cultivated land to its production.

The crop has been prioritised by Ghana's Ministry of Food and Agriculture (MoFA) because it is drought tolerant and can withstand high temperatures. Sorghum remains important for food security in Northern Ghana despite being overtaken in recent times by maize and rice as the lead staple foods. Its potential as an industrial crop is also rising due to its use as a substitute for imported barley by the formal brewing industry in the country.

The European Union intervention

The European Union (EU) is investing €147 million of the 11th EDF National Indicative Plan in Ghana to promote sustainable agribusiness development in order to increase the incomes of SHF and expand opportunities for the most vulnerable, notably youth and women.

In line with the priorities of the Northern Development Authority (NDA), the EU targets the Upper West, Savannah and North East Regions via 3 interconnected programmes: (i) the Productive Investments Programme, which focuses on improving access to water for agricultural production; to physical market infrastructure, roads and storage facilities; and to energy for productive uses in value chains (VCs); (ii) the Resilient Agriculture against Climate Change (REACH) focusing on protection of natural resources to foster sustainable and inclusive improvement in the rural economy; (iii) the Market Oriented Agricultural Programme (MOAP) under which €25 million is being invested in high-value crop VCs including sorghum. The MOAP is being implemented by the MoFA and GIZ, initially in Southern regions of Ghana, but has been extended to the Northern regions since 2017 with the support of the EU.

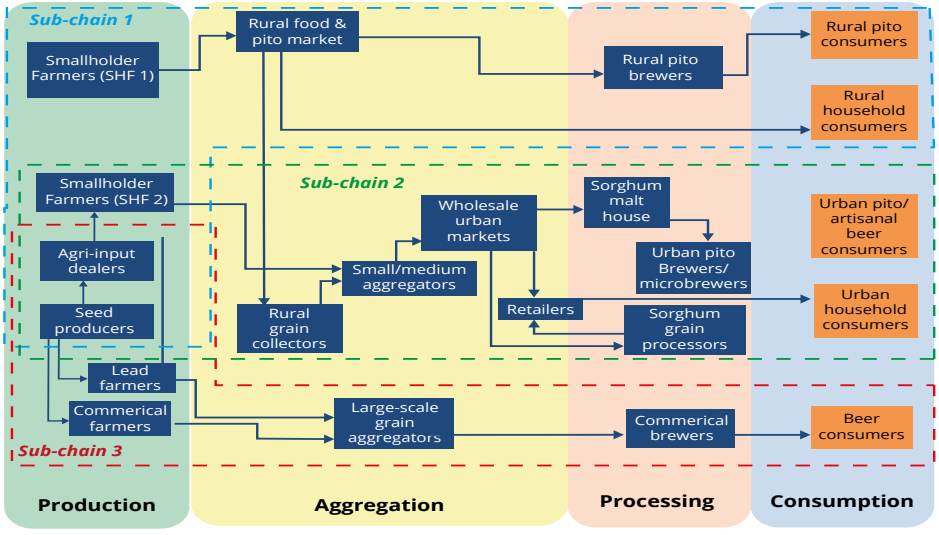

Figure 1 : The sorghum value chain in Ghana

Functional analysis

A multipurpose crop with high industrial potential

Sorghum is an energy-rich staple with **important nutrition benefits**. It is gluten-free and contains essential minerals such as potassium, phosphorus and magnesium. In Ghana, the milled grain is used to prepare a traditional porridge (*tuo zaafi*). **Sorghum brewing to produce a traditional beer (*pito*) is an important cottage industry in Northern Ghana**. The formal brewery industry in the country is aiming, in the long-term, to **replace imported barley malt** with domestic sorghum malt in producing established brands of alcoholic and non-alcoholic beverages, thereby reducing demand for foreign exchange without compromising on the quality of their products.

Production trend and crop performance

Sorghum production is mainly concentrated in Northern Ghana. Between 1960 to 1990, production increased continuously, peaking at over 387,000 t in 1998. Since then, growth in sorghum output has trended downwards, falling to 278,000 t in 2018 (Figure 2).

Though it is perceived as a food security crop, sorghum prices have consistently been higher than maize since 2008. In 2010, for instance, maize was about 25% cheaper than sorghum whilst in 2017 it was close to 35% cheaper. This may be one of the reasons why **maize is overtaking sorghum in terms of relative importance in the food systems in Northern Ghana**.

Among the key factors affecting the sorghum VC performance is the **low average yield, between 0.5 to 1.2 t per ha in the country**. This is mainly due to the fact that most SHF cultivate indigenous varieties with inherent low yield potential and scarcely apply yield-enhancing inputs such as fertiliser. When they practice traditional mixed cropping systems, the plant density tends to be low. In comparison, the average yield for sorghum is substantially higher in Botswana (about 5 t/ha) as well as in Ethiopia and Uganda (about 2 t/ha). Nevertheless, evidence shows that **when farmers apply inputs**, even at lower levels, **the impact on yield is substantial**.

Farmers involved in three different sub-chains

The VC consists of **three sub-chains**, based on the main end products supplied to consumers (Figure 1). **Sub-chain 1** consists of **mainstream SHF (SHF1)**, who cultivate about 1.5 ha of land with traditional low-yield red varieties. Though they may use tractor services for ploughing, they do not apply any fertiliser or pesticides. The grain they produce is mainly for household consumption and for brewing *pito* which is consumed within the community.

The **emergent SHF2** are involved in **sub-chain 3** targeting an emerging industrial brewery sector with international standards. They allocate 2.4 to 2.8 ha of their land to white sorghum production. They receive support from **large-scale aggregators** and commercial farmers in the form of credit that they repay by supplying grains of equivalent value, to acquire inputs (fertiliser and pesticides) although the support covers only 20% of their needs. Aggregation is facilitated by lead farmers who are paid a commission based on the grains volume. Also engaged in sub-chain 3 are **lead and other medium-scale farmers (LMF)**, who produce and sell to the industrial brewery sector. On average, they cultivate 5-6 ha of sorghum per season. Finally, some **commercial farmers (CF)** produce exclusively for the industrial brewery sector.

Sorghum grains which the SHF2 cannot sell in sub-chain 3 is sold directly to **small/medium-scale aggregators** who operate in **sub-chain 2** and deliver to wholesale markets in urban areas.

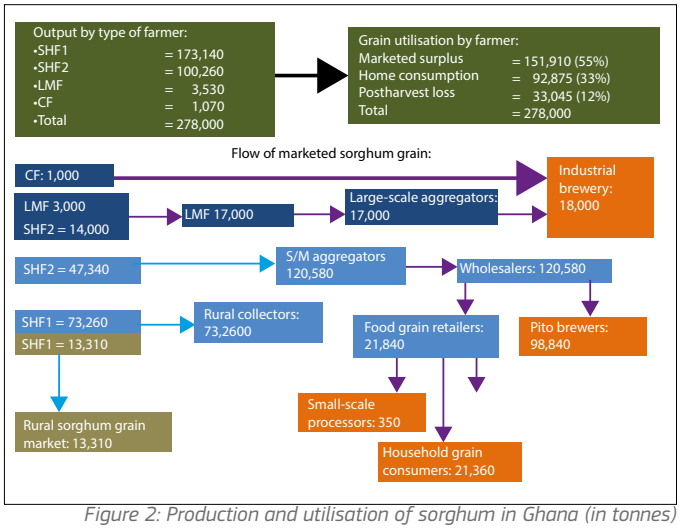

Figure 2: Production and utilisation of sorghum in Ghana (in tonnes)

Policy programmes beneficial to the sorghum VC actors

One of the flagship initiatives by the Government of Ghana (GOG) is the **Planting for Food and Jobs (PFJ) programme** under which the GOG distributes improved seed, fertiliser and pesticides to farmers, including sorghum farmers. A subsidy of 50% provided by the GOG aims to address affordability challenges which farmers face. However, it is evident that many SHF are unable to buy inputs to which they are entitled under the PFJ mainly because of acute liquidity problems which they face during the planting season.

The **One District One Warehouse (1D1W)** GOG initiative is expected to improve postharvest crop handling by making available modern, off-farm storage infrastructure.

Economic analysis

Viability for the actors

The operations of all actors in the sorghum VC are profitable. Nevertheless, assuming the **SHF1** cultivated only sorghum (currently it only counts for 30% of the planted area), the projected annual operating income would be about €132, which **is below the national poverty line** (€245 in 2017) **and also far below the national minimum wage** (which is about €565 per annum). The emerging **SHF2**, who receive pre-financing to acquire inputs and ploughing services, record over 25% increase in yield and obtain premium prices for selling part of their crop through sub-chain 3. The projected annual operating income the SHF2 would obtain from growing only sorghum (instead of 40% of the planted area) is €287, which **is above the national poverty line though below the national minimum wage**.

The annual operating incomes are €815 for the LMF (if only sorghum instead of the current 60% of the planted area), €900 for the rural grain collector, €2,650 on average for the small/medium grain aggregator, €250 for the grain retailer selling also other cereals, €4,700 for a *pito* brewer and €18,000 for a microbrewer.

Effects within the national economy

The VC in 2018 generated a **total value added (VA) estimated at €188 million** and represents **0.3% of Ghana's GDP and almost 2% of agricultural GDP**. The contribution to total VA by sorghum processors is 42%; whilst suppliers of goods and services (e.g. fuelwood, brewing ingredients, transport, ploughing services, and packaging) contribute about 32%. Farmers account for 18% and the remaining 8% is contributed by grain traders.

The VC is a **net contributor to public finances**, providing about €29 million per year in the form of taxes and local council levies. The bulk of the tax revenue is contributed by the industrial brewery (about 65%) and the suppliers of goods and services (30%). This contribution is net of the subsidies distributed via the PFJ, which are estimated at €1.2 million.

About €36 million is spent on imported goods and services within the VC and only small volumes of sorghum grain are reportedly exported into regional markets, so **the contribution of the VC to the balance of trade is negative**. Nevertheless, the VC distributes incomes into the national economy as **the rate of integration is 78%** (share of total VA in the value of production). Moreover, the use of sorghum grain as a local raw material in the industrial brewery is saving about €6.6 million in imports of malt barley.

Sustainability within the global economy

The domestic resource cost (DRC) ratio in the VC is estimated at 0.35, which is well below unity (i.e. <1) and indicates that **the VC has a comparative advantage and is viable within the global economy**. The nominal protection coefficient is 1.1, an indication that players in the VC currently enjoy a certain level of protection (mainly in the form of subsidies farm inputs).

Growth inclusiveness and employment

The bulk of the total VA, about 37%, is net incomes to operating actors in the VC. Small and micro-scale actors accumulate nearly 80% of this net operating income. Of the total VA, about 22% is allocated to wages; 16% is contribution to public finances; 16% represents charges and fees paid to financial institutions, 8% is depreciation; and less than 1% rent. **So more than 50% of the VA benefits to small and micro-actors (30%) and workers (22%)**. This is evidence of growth inclusiveness in the VC.

The VC sustains over 180,000 jobs, including self-employment opportunities for SHF as well as people engaged in sorghum grain distribution (collectors, aggregators and retailers). There are also over 5,500 self-employed *pito* brewers, in a sector which employs about 15,000 low-wage workers, almost all women. These "workers" actually take advantage of their employment in *pito* brewing to save start-up equity for their own enterprises. There is also evidence that new low-wage, temporary ("by-day") labour employment opportunities have emerged along with more permanent and better-remunerated jobs as a result of commercial sorghum cultivation and grain aggregation in sub-chain 3.

WHAT IS THE CONTRIBUTION OF THE VALUE CHAIN TO ECONOMIC GROWTH?

The VC is economically sustainable. The operations of all actors are profitable and generate annual incomes which are over the poverty line, except for the numerous SHF1 farmers in the traditional sub-chain 1. They cannot subsist on sorghum alone and generally diversify into the production of maize, groundnuts, rice and other food crops. It is evident that securing PFJ funding to acquire inputs is critical in transitioning towards a more productive and sustainable situation for farmers as shown by the case of the SHF2.

Though the contribution to the agricultural sector GDP is quite modest, there is evidence that this can rise significantly if the sorghum grain distribution chain is modernised and there is increased investment in more diversified downstream processing activities, as demonstrated by sub-chain 3. Emergency of diversified industrial actors shall be promoted to minimise risks of dependency from only one industrial brewery. The VC is a net contributor to public finances, is well-integrated into the national economy and has a comparative advantage within the global economy, making it possible for the domestic brewery industry to pursue an effective import substitution strategy as it is less dependent on imported malt barley.

Social Analysis

Figure 3 and the table to the left provide a picture of the main social implications of the VC activities in 6 strategic domains.

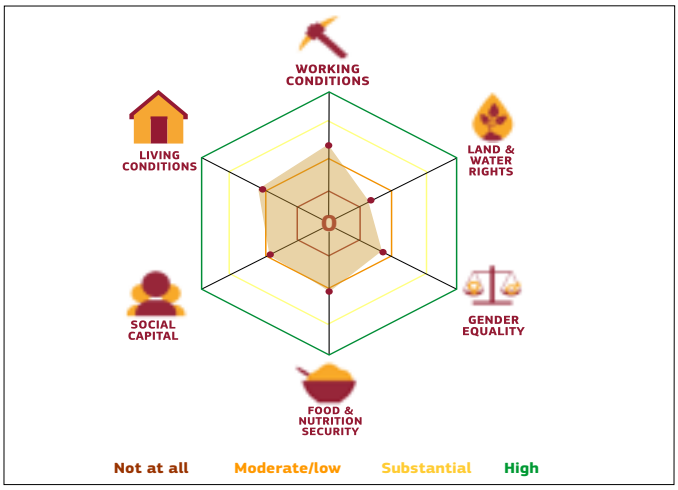

Figure 3: Social profile

IS THIS ECONOMIC GROWTH INCLUSIVE?

The VC is highly inclusive, as most of the income generated accrues to small and micro-scale actors: small-holder farmers (accounting for about 95% of total production), small/micro-scale grain collectors and retailers, *pito* brewers and a workforce that supports the system of production, trading and processing. Women benefit from employment opportunities as they carry out most of the tasks associated with production and the traditional processing, especially *pito* brewing. Both men and women gain a degree of financial independence from their involvement in the VC. Returns from small-scale grain production benefit the local economy and are invested in children's education, health care, housing, small businesses and in the farm. However, the VC contribution to inclusive growth could be unlocked if effective smallholder farmer associations are in place to mitigate power imbalances between actors. Farm labour wages and working conditions at the *pito* breweries remain harsh, a challenge which can be addressed by deploying available low-cost technologies.

IS THIS VC SOCIALLY SUSTAINABLE?

The VC is socially sustainable but its potential has yet to be unlocked. As a cash crop, sorghum offers opportunities for SHF as well as SMEs involved in grain marketing, *pito* brewing and sorghum grain processing. The VC offers interesting rural employments for youth, who engage in sorghum production as SHF2 linked to large-scale aggregators and commercial farmers with outgrower schemes. However, the majority of them are being employed on an informal, casual or temporary basis.

The mains issues requiring attention are: the customary land tenure system that needs reform and hampers access to credit and women's access to land; strengthening of farmer based organisations to increase trust and balance powers in the VC; health services and accessibility as well as vocational training opportunities.

Working Conditions	• Labour laws reflect international conventions, but enforcement is low (especially for farm wage labour). Little monitoring and control of working conditions and job safety is performed by the Ministries, although no violation has been reported in the sorghum VC; • Working conditions at the industrial brewery sector seem favourable and attractive; • Farm wage labourers employed by CF are vulnerable; • Working conditions for *pito* brewers are severe, possibly putting the actors' health at risk; • The sorghum VC is attractive and offers opportunities for youth and women.
Land and Water Rights	• Customary law still prevails in Ghana. Land titles and formal regulation for investments are uncommon (regulation is based on chief systems, goodwill and personal relations and preferences); • Access to land and land title for women and access to credit are thus limited by the informality; • Although there is currently no evidence of land expropriation in sorghum, this is potential future risk due to the current land tenure system.
Gender Equality	• Women are active at all stages of the sorghum VC: farmers, workers, retailers and *pito* brewers. • Strong traditional role and task division between men and women; • Little time for women in rural areas to exercise leadership, although more opportunities are present at the level of the industrial breweries; • Participation in the VC does not influence on the decision power for women at production and expenditure level, which remains low; • Very challenging for women to get access to credit due to lack of collateral.
Food and Nutrition Security	• The red (traditional) variety is an important yet underestimated nutritious food crop – used mainly for household consumption and *pito* brewing; white sorghum is considered more as a cash crop; • Temporary problems in food accessibility between June-August for the majority of Northern populations, including sorghum farmers/brewers; • Sorghum is currently a missed nutritional opportunity, especially for children (taboo for children to consume the unfermented *pito*).
Social Capital	• Lack of well organised farmer associations, representations and cooperatives; lack of one farmer voice; • Lack of transparency and information within the VC; • Horizontal and vertical trust between VC actors is low (enchaining late payments); • Power imbalances between the main industrial actor and the SHF, or between commercial farmers and SHF in input supply; • Lack of effective lobby and advocacy sector platform.
Living Conditions	• Access to and affordability of health care is a huge challenge in rural areas mainly in the North; • Housing is improving but in remote rural areas it is still very poor and traditional; • Primary and secondary schools are available, but accessibility and affordability are difficult in rural areas.

Environmental analysis

The Life-Cycle Assessment was carried out considering the production of 1 kg of grain for the cultivation phase and 1 litre of beer at brewery gate. This calculation was done for the 3 sub-chains and two alternative scenarios: reducing firewood use in pito brewing through the introduction of ovens; or improving farming practices for an increase in grain yields (2 t/ha, the potential attainable yield for sorghum in Ghana).

Potential impacts of cultivation

Cultivation affects mostly the ecosystems quality (Figure 4), mainly due to land use and to freshwater eutrophication derived from soil erosion and chemical fertilizers, applied by all farmers except SHF1. Barley cultivation in Europe does not have such high impacts on ecosystems quality, given the high grain yield of barley (6.6 t/ha).

Human health is affected to a lesser extent by sorghum cultivation, in particular in low-input systems. Human health is influenced by global warming (N2O emissions from the soil, production of NPK – nitrogen, phosphorus, potassium – for fertilisers and combustion emissions for mechanical operations) and by fine particulate matter formation, derived from nitrogen fertilization and from mechanical operations.

Potential impacts of the sub-chains

In sub-chain 1 and a part of sub-chain 2, cultivation had a major contribution to resources depletion and ecosystems quality (around 50% in both). Another major contribution, for human health, originates from firewood extraction and combustion for the brewing process (Figure 5).

For these sub-chains including pito brewing, the main hotspots are firewood use, associated with forest degradation and subsequent changes in land use. Indeed, potential damage to ecosystems along with low grain yields and a relatively low conversion rate of grains to *pito*, **prevents sub-chain 1 and part of sub-chain 2** (urban pito brewing) **from being environmentally sustainable**. This is also due to the potential damage to human health associated mainly with high levels of global warming derived from the use of firewood.

The part of the sub-chain 2 linked to microbreweries with use of locally produced SG grains for brewing can be considered **environmentally sustainable**; yet, more efficient land use by improving grain yields, would further improve its environmental performance.

Regarding **sub-chain 3**, the potential environmental impacts of brewing with sorghum grains from Northern Ghana does not differ significantly from brewing with imported barley malt from EU, even when including transport to Ghana.

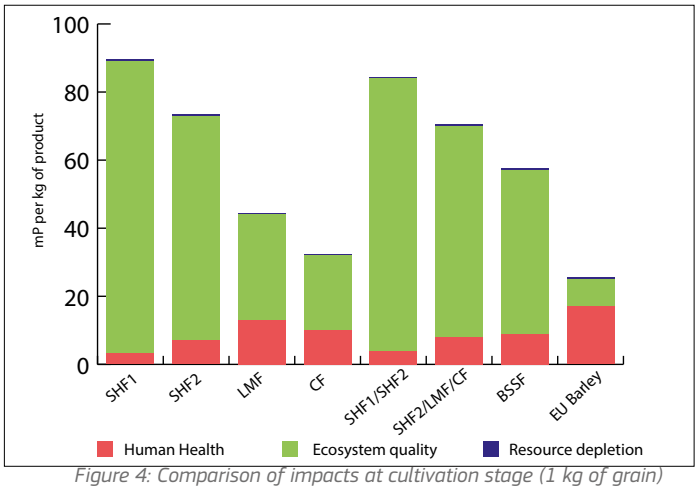

Figure 4: Comparison of impacts at cultivation stage (1 kg of grain)

BSSF: Best Scenario of Sorghum Farming (improved yield to 2t/ha for SHF2 and reduced post-harvest losses)

	Resources	Ecosystems	Human Health
Sub-chain 1	Cultivation (±50%) Firewood for brewing (±30%) Transport of grains (±10%)	Firewood for brewing (±50%) Cultivation (±50%)	Firewood for brewing (>95%)
Sub-chain 2	Energy at brewery (>80%)	Cultivation (>95%)	Energy at brewery (±50%) Cultivation (±15%) Direct water use (±15%)
Sub-chain 3	Packaging material (±50%) Energy at brewery (±30%)	Cultivation (±75%) Packaging material (±15%)	Packaging material (±75%)

Figure 5: Contribution of the main factors to the damages for the 3 sub-chains

IS THE VC ENVIRONMENTALLY SUSTAINABLE?

For all the situations, the main environmental impacts affect ecosystems quality and human health, while impacts on resources are very low. Depending on the sub-chain, the main contributions derive from: firewood extraction and combustion as well as cultivation in sub-chains 1 and 2 (urban pito brewing), cultivation alone in sub-chain 2 (microbrewing) and packaging materials in sub-chain 3.

There are margins for improvement in all three sub-chains. In sub-chains 1 and 2, the overall environmental impacts of pito brewing are the highest, with the impacts of microbrewing and industrial brewing being around one-third of that of pito brewing. The introduction of more efficient ovens for pito brewing can have very positive impacts from both human health and ecosystem quality perspectives. Indeed, it would contribute to the reduction of firewood consumption and of direct exposure of brewers to harmful open fire pollutants. In addition, it will contribute to the reduction of forest degradation. Moreover, scenarios show that there is significant potential for improving environmental performances in sub-chains 1 and 2. Sub-chain 3 has yet an overall acceptable level of environmental sustainability.

Conclusions & recommendations

Sorghum is an important food crop in Northern Ghana but also has substantial potential as a cash crop, offering opportunities for SHF and small/medium-scale entrepreneurs. Its growing prominence as an industrial crop in recent years is due to entry by a major industrial brewery into the sorghum market, which is using in place of imported barley to produce alcoholic and non-alcoholic beverages. This has catalysed the emergence and rapid growth of large-scale aggregators and commercial sorghum farmers. However, the traditional key actors, including *pito* brewers, remain the largest contributors of value added in the VC. The *pito* brewing is dominated by women and is unlikely to be squeezed out of the market because they utilise the red varieties of sorghum which is not preferred by the industrial breweries.

The sorghum VC is sustainable and highly inclusive. It has high potential for growth and transformation, including significant upscaling of downstream value addition. The following recommendations address the challenges and risks that hamper the VC, thus helping to unleash the substantial untapped potential in the VC:

- **Improve farmers' productivity will have significant positive economic, social and environmental benefits**: this can be achieved through designing and promoting good agricultural practices including agroecological ones; improving access to extension services, including weather advisories (especially as Ghana is affected by erratic and changing weather patterns); and enhancing information systems accessible to SHF, including market information and reliable weather forecasts.
- **Boost seeds supply**: variability of seeds quality creates a major risk that has affected commercial farmers in particular. It is attributable in part to severe deficits in human capital, in part to funding constraints faced by the Savannah Agriculture Research Institute (SARI), which need to be addressed. Any intervention shall focus on both the white and red sorghum varieties and also shall support the diversity of farmers seeds.
- **Promote strong farmers' organisations (e.g. cooperatives)** in order to reduce the cost of accessing services (e.g. extension) and strengthening their bargaining position (they are virtually excluded in negotiating producer prices paid by the big players).
- **Boost growth and diversification in the formal offtake of sorghum grain**: in a situation where there is only one major offtaker, there is a risk for players in sub-chain 3. This became evident also during the COVID-19 crisis and can be addressed by: diversifying players; promoting of the emergent microbreweries, possibly through access to low-cost start-up capital; encouraging bottling of non-alcoholic pito; and boosting sorghum grain processing by enabling the micro-scale processors to scale up their operations.
- **Strengthen capacity at the aggregation level**: a sustainable growth in diversifying downstream SG processing requires investment in aggregation facilities, storage infrastructure and grain handling services. Private aggregators are already entering this segment but will need additional financing in order to scale up and improve the quality of services they provide.
- **Promote financing packages to boost uptake of yield-enhancing inputs**: The VC offers an opportunity for de-risked financing targeting SHF, which can be anchored around aggregators or commercial farmers providing inputs credit which is interlocked with output supply agreements. This is already happening in the MOAP's Revolving Fund and can be scaled off by expanding participation by rural and community banks as well as commercial banks in the Northern regions.

© Christine Plaisier

Value Chain Analysis for Development (VCA4D) is a tool funded by the European Commission / DEVCO and is implemented in partnership with Agrinatura.

Agrinatura (http://agrinatura-eu.eu) is the European Alliance of Universities and Research Centers involved in agricultural research and capacity building for development.
The information and knowledge produced through the value chain studies are intended to support **the Delegations of the European Union** and their partners in improving policy dialogue, investing in value chains and better understanding the changes linked to their actions. VCA4D uses a systematic methodological framework for analysing value chains in agriculture, livestock, fishery, aquaculture and agroforestry. More information including reports and communication material can be found at: https://europa.eu/capacity4dev/value-chain-analysis-for-development-vca4d-

This document is based on the report "Sorghum Value Chain Analysis in Ghana" 2020, by Gideon Onumah (NRI), Christine Plaisier (WUR), Ricardo Villani and Gregory Komlaga. Only the original report binds the authors.