CBI
Ministry of Foreign Affairs

Food Loss in Nigeria

Value Chain Analysis (VCA) *of Tomato, Onion, Chilli value chains*

Commissioned by The Centre for the Promotion of Imports from developing countries (CBI)

SureChain

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Acronyms

AU	African Union
BoA	Bank of Agriculture
CBI	Centre for the Promotion of imports from Developing countries
CBN	Central Bank of Nigeria
CE	Circular Economy
CGIAR	Consultative Group on International Agricultural Research
ETLS	ECOWAS Trade Liberalization Scheme
EU	European Union
FACAN	Federation of Agricultural Commodity Association
FAO	Food and Agriculture Organisation
FCT	Federal Capital Territory
FMARD	Federal Ministry of Agriculture and Rural Development
FRSC	Federal Road Safety Commission
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GHG	Green House Gas
HA	Hectare
IGO	Inter-Governmental Organizations
IITA	International institute of Tropical Agriculture
ITC	International Trade Agency
KG	Kilogramme
MT	Metric tons
NAERLS	National Agricultural Extension and Research Liaison Services
NAIC	Nigeria Agricultural Insurance Corporation
NARTO	National Association of Road Transport Owners
NASC	National Agricultural Seed Council
NBS	National Bureau of Statistics
NEPC	Nigerian Export Promotion Council
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGO	Non-Governmental Organizations
NICOP	Nigeria Competitiveness Project
NIHORT	National Horticultural Research Institute
NIPC	Nigeria Investment Promotion Commission
NRCRI	National Root Crops Research Institute
NSPRI	Nigerian Stored Products Research Institute
OPMAN	Onion Producers and Marketers Association of Nigeria
RMRDC	Raw Material Research & Development Council
RPC	Reusable Plastic Crates
RVO	Netherlands Enterprise Agency
SDG	Sustainable Development Goals
SME	Small and Medium Scale Enterprises
STEEP	Social, Technological, Ecological, Economic and Political
TOGAN	Tomato Growers Association of Nigeria
TOPAN	Tomato and Orchard Producers Association of Nigeria
ToR	Terms of Reference
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USD	United States Dollars
VC	Value Chain
VCA	Value Chain Analysis

Executive Summary

Nigeria is one of the priority countries for the Dutch government's aid for trade development cooperation policy. This has been underlined by the 2018 policy note 'Investing in global prospects'.[1] The Dutch private sector also has interest in Nigeria. VNO-NCW in its 2019 Africa strategy mentions Nigeria as the biggest economy on the continent and one of its 3 target countries on the African continent. Agriculture and food & nutrition security are priority sectors defined for Dutch interventions in Nigeria, and food loss & waste being one of the SDGs (SDG 12: 12.3) which the Netherlands intends to address.

Nigeria generates some 32 million tonnes of waste per year (including all stages of the value chain). Intervention in the three VCs identified (i.e., tomato, onion and chili) presents an opportunity to support Nigeria in addressing SDG 12. Annual loss of tomatoes in Nigeria is between 45 – 60 percent of the total production, while 50 percent of onions and 20-30 percent of chili are lost at different parts of the chain.

Food Loss is still a big challenge for Nigeria due to various reasons. Most of the VCs that contribute significantly to food loss (e.g., tomato, onion and Chilli) are not well developed (or advanced) and organized in terms of production and processing techniques, equipment, technology and governance.

Furthermore, there is poor enabling policy environment to catalyze development of the VCs. Chain supporters and influencers in Nigeria have also not taken a holistic view when proposing interventions or solutions to tackle this issue.

This study identifies some of the main causes, constraints and opportunities for addressing food loss in the three value chains and proposes quick wins, generic and cluster interventions for RVO to consider (as summarized below).

- **Causes and constraints leading to food loss in tomato, onion and chili value chains**:
  - Lack of good quality input (seeds and fertilizers)
  - Low Skills on crop management and GAP
  - Diseases, Pests and Rodents
  - Poor coordination with the rest of the chain and unmanaged seasonal production glut
  - Poor crop handling and storage at harvesting
  - Security Incidents
  - Insufficient modern processing facilities, and processing equipment and methods
  - Poor vehicle condition used during transport, overloading of trucks and the use of poor packaging materials (such as raffia baskets) during transport
  - Delays by police and customs during long distance transit
  - Poor road condition during transportation
  - Lack of efficient refrigeration during transport
  - Traffic constraints and rough offloading at major vegetable markets
  - Importation of tomato pastes and concentrates
- **Opportunities**
  - There are several existing initiatives to reduce loss within the three value chains, including initiatives by Dutch companies and institutions
  - There is possibility of applying circular economy solutions to address food loss in the three value chains
  - Some local solutions already exist, such as Zero energy cooling chambers, locally developed reusable plastic crates for packing during transport, aggregation packing houses, solar drying system, and CoolHubs.
  - Value addition through processing is possible for each of the value chains
  - There is possibility of applying digital smart tools such as Blockchain, Artificial Intelligence, Drones, satellite imaging, digital sensors, and advanced data analytics.
  - There is possibility of engaging youth in elaborating food loss solutions
  - Possibility of leveraging existing active associations to address food loss in the three value chains
  - There is potential for cool chain transport and railway as alternative to road
  - The government's Anchor Borrowers Programme aimed at creating a link between off-taker companies involved processing and smallholder producers of some agricultural commodities, is accessible to the three value chains.
  - There is an opportunity to leverage on Nigeria's existing waste policies and regulatory frameworks to address food loss in food value chains

- **Interventions**: Sector experts interviewed maintained that, any proposed intervention or solution by RVO, CBI and other VC actors should take a holistic approach. No meaningful results would be achieved on the food loss issue, without an intervention with a long-term time horizon; engagement and partnership with the Nigerian government, investments at all stages of the value chains, and build mutual trust between actors and cooperation of all stakeholders. In addition to some quick wins and generic interventions, we recommend that RVO and CBI apply a cluster approach to solve the key challenges that result in significant food loss in the three value chains. Whereby, multi-stakeholder clusters (i.e., a combination of at least companies, government agencies, NGOs, Institutes) are developed between Dutch and Nigerian stakeholders around topics that could address food loss.

  Quick wins:
  - Join EU/GIZ NICOP initiative, extend its duration and expand the focus to cover onions VC
  - Partner with IFC TechEmerge Programme to support innovations on Temperature -Controlled Logistics in Nigeria.
  - Support the scale-up (or further development) of existing local Initiatives:
  - Encourage the replication of successfully funded RVO Projects (particularly FDOV and PSD Toolkit) by Dutch companies/NGOs, which are ongoing in other countries or other sectors (but are applicable to addressing food loss in tomato, onion and chili VCs in Nigeria).

- *Generic Interventions:*
  - Engage with the Nigerian Government to address some of the challenging political economy issues, to ensure a better enabling environment for the value chains to operate in. Such as: support the Nigerian Government to develop a central strategy on food loss from agri-food value chains; provide financial and technical support to strengthen tomato, onion and chili associations; encourage sensible reforms in Nigeria's public security sector; and encourage FMARD through diplomatic channels, to fully implement the Tomato sector policy and to develop policy reforms for other value chains such as Onions and Chili.
  - Financial support to improve roads, energy infrastructure as well as the machinery used in the VCs
  - Access to finance and (particularly) financial capacity development for SMEs in tomato, onion and chili value chains to ensure that they are investment ready.
  - Stimulate the Circular Economy approach to address food losses in Nigerian food value chains (with accent on the selected three VCs – tomato, onions and Chilli).
  - Communication and education campaigns targeted to reduce food loss (and wastage)
  - Organize a National Hackathon on solutions for food losses in the selected VCs

- *Cluster Interventions:* Increasingly, the cluster approach is used by most countries to organize a market-led economic development strategy by initiating dialogue between the various actors in their relevant systems of innovation. Four main clusters are recommended corresponding to the causes and constraints enumerated above:

  - Cluster on Good Agricultural Practices (GAP)*:* This cluster would focus on productivity in the three value chains and the provision of improved seeds and fertilizers as well as transfer of best practice information to smallholder tomato, chili and onion farmers. It would also focus on supporting producers with technology and materials for greenhouses and introduce digital/ICT tools for Smart farming, etc. and to curb production inefficiencies and losses in the three VCs. In addition, the cluster would explore the possibility of linking GAP and extension training activities with youth vocational apprenticeships/internships.

  - Cluster on Processing: This cluster would ensure that processing equipment and machinery (instrumental to curbing food loss) are developed/ fabricated in Nigeria and provided at low cost to SMEs in the VCs. The cluster program would also focus on ways to provide access to finance for SMEs in the three VCs to hire processing equipment and machinery when available in the country. The cluster would explore possibilities to export fairly used processing equipment and machinery to SMEs in Nigeria, as well as the know-how to operate and service them.

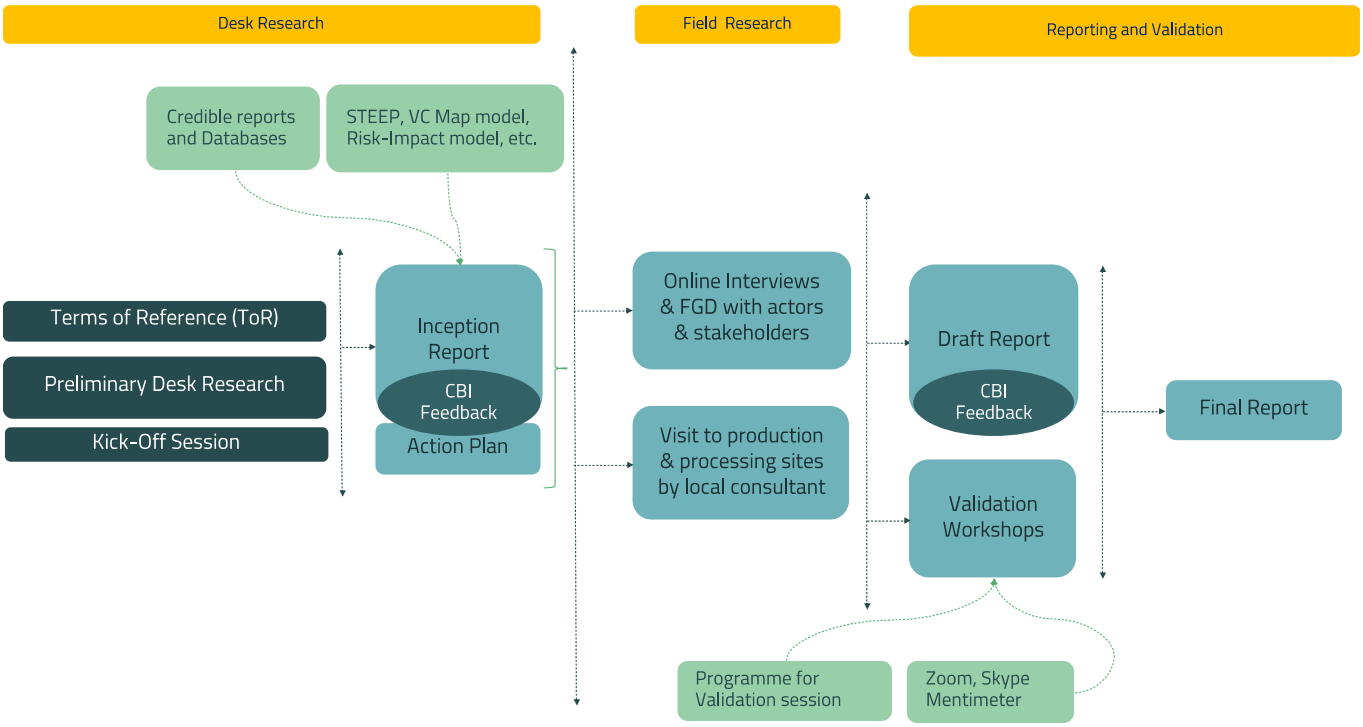
  - Cluster on Logistics: This cluster would focus on improving infrastructure and coordinated transportation (logistics) including cold chain facilities. It would introduce digital ICT applications to improve actor coordination and communication, as well as product traceability and chain transparency.

- Cluster on Infrastructure: The focus of this cluster would be on providing solutions for road construction and rehabilitation; revitalization of cargo rail as a viable alternative means for transporting tomato, onion and chili along the Northern – Southern trade corridor; develop more off-grid power solutions and construction of ultra-modern markets.

Chapter 1. Summary of Research Approach

This section presents the research approach and updates on the desk research sources and field research work (i.e. interviews, site visits and validation workshops). In Figure 1 below, a simplified schematic representation of the entire research approach is presented.

Figure 1: Simplified schematic of the research approach



1.1 Research Questions

One of the main obstacles in Nigeria that was identified in the value chain selection is food loss. This obstacle has been selected to deepen out further and to analyze throughout the different parts of the chain. The Value Chain Analysis of the value chains of tomatoes, onions and chillies, should contain the following elements:

1. Mapping of food loss throughout the value chain
2. Actors, structure and governance of the VC
3. Sustainability and CSR
4. Opportunities and possible interventions to decrease food loss in the VC - divided to the different players in the field (government, local private parties, knowledge institutes, Dutch private parties, etc.)

Below are the core research questions that were addressed in the analysis for each of these elements (Besides the detailed guiding questions for each element, as provided in the ToR):

- Why are food losses such a big challenge in Nigeria and why is this theme also important from a Dutch policy perspective?
- Where exactly in the value chains of the three aforementioned products food loss exists?
- Who or what kind of organizations, actors, supporters are involved?
- What programmes and activities are already being implemented in Nigeria concerning agricultural production and food losses (including commercial activities by for instance Rijk Zwaan, East West Seeds, Bejo Seeds)?
- What key challenges and solutions are identified by the Nigerian stakeholders?
- What lessons could be learned from past interventions and/or are already available?
- What can be done to lift the food loss issue at the different value chain stages?
- Who could tackle the constraints?

- Some additional points of attention:
- Food loss is a very interesting subject in relation to Circular Economy. An analysis regarding the opportunities for circular solutions to prevent food losses should be added.
- Digital/ICT applications may also offer solutions that haven't been thought of so far. The link between ICT and agriculture can also make agriculture more attractive to youths.
- There are interesting links possible with the Horti-Include programme (focusing on vegetable production in Kaduna) which is currently in development. It would be an added value if the HortInclude consortium partners (SNV, WUR, Agriterra) will take part in the roundtable workshops in the validation phase of the study.

1.2 Desk Research

The desk research phase commenced during the second week of August with website and database searches and report reading (literature review). In general, desk research was used to provide qualitative and quantitative data to address mainly Elements 1, 2, 3 (and partly 4) of the VCA. This phase utilized and analyzed several existing data from credible sources, both written and databases. After the desk research, an inception report was provided to CBI and RVO.

1.3 Field Research (Interviews and Validation Workshop)

The field research phase was used to provide answers to all four Elements. Information gathering during the field research will be done mainly through online interviews of key stakeholders. Although, the EU-based consultants could not travel to Nigeria due to COVID-19, the local consultant was able to make some safe travels to Kaduna, a critical production location for the 3 VCs, in order to complement the online interviews with some face-to-face interviews. Obviously, the health and safety of the local consultant was prioritized at all times. See list of interviewees in Annex 1.

1.4 Validation workshop

The preliminary conclusions and recommendations of the draft VCA report were validated with key stakeholders in Nigeria on the 26th of November. An online validation workshop was organized with the participation of diverse actors and stakeholders in Nigeria and Europe. Overall, 30 participants joined the online validation workshop, representing each stakeholder group. See list of participating organisations in Annex 2. During the validation session there was interactivity, with surveys organized using menti.com. See Results of the surveys and a summary of points stressed by participants in Annex 2.

1.5 Reporting

Prior to the validation report, a preliminary draft report was provided to CBI and RVO prior to the validation session. Based on the findings of both desk and field work (including validation), the team delivered a draft VCA report. An online presentation of the key findings was conducted with selected Dutch industry stakeholders, CBI, RVO and Dutch Ministry of Foreign Affairs colleagues. All opinions, comments and suggestions from stakeholders (including CBI, RVO and Ministry of Foreign Affairs) were processed prior to submitting the final VCA report.

Chapter 2. Mapping of food loss throughout the value chain

This chapter presents findings from mapping of food loss in the three value chains (tomato, onion and chili). The goal is to gain an understanding of the production and demand of the three value chains, the SWOT analyses for each value chain (based on interviews), an indication of where and how food loss occurs in these three value chains, the main causes and constraints related to food loss in the value chains and some programs and initiatives being implemented to address food loss in Nigeria.

2.1 Production and Demand of Tomato, Onion and Chili

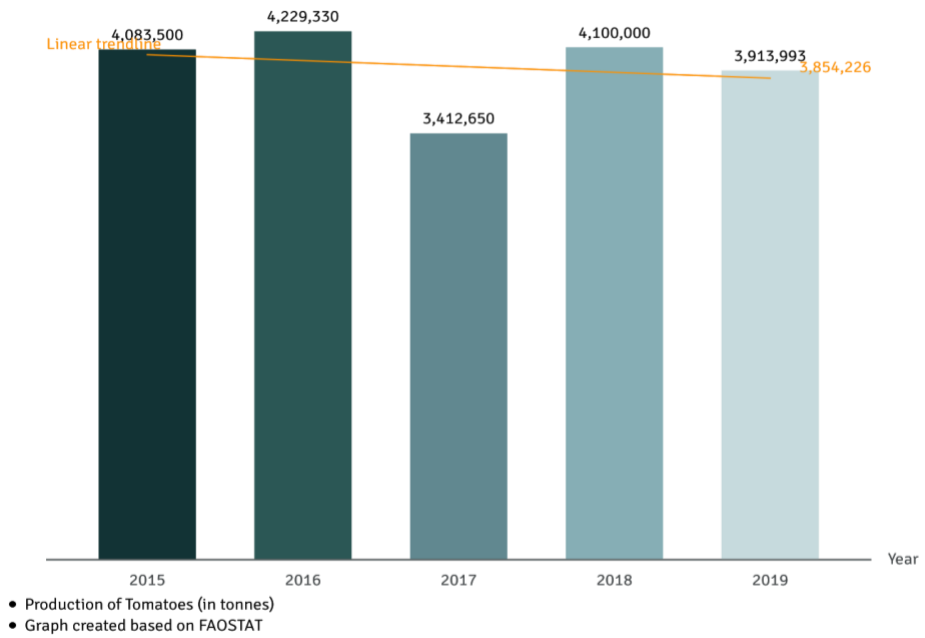
The table below shows the developments in production over the last 5 years for each of the VCs.

Production (tonnes) of Tomatoes, Onions and Chilli in Nigeria 2015 – 2019 (FAO)					
Associations	2015	2016	2017	2018	2019
Tomatoes	4,083,500	4,229,330	3,412,650	4,100,000	3,913,993
Onions (Green)	235,000	235,276	243,195	243,544	245,201
Onions (Dry)	985,400	997,900	1,014,810	971,110	938,417
Chilli Peppers (Green)	741,260	745,855	744,064	745,715	747,367
Chilli Peppers (Dry)	60,299	65,004	67,197	69,034	70,871

2.1.1 Tomato

Nigeria is the 14th largest producer of tomato in the world and the 2nd largest Tomato producer in Africa. Tomatoes are mainly produced in Kaduna and Kano states. These two states jointly produce more than 50 percent of all tomatoes in the country.[2] However, tomatoes are commonly produced almost all states (24 out of the 36 States of Nigeria and FCT). They are often cultivated using intercropping and in rotation with other vegetables (such as onions, peppers, lettuces, carrots, cabbages and peas) to reduce the susceptibility to pests and diseases. Similarly, Nigeria is the 13th the largest importer of tomato pastes in the world and the 2nd largest importer of tomato paste in Africa. Nigeria produced more than 3.9 million tonnes of tomatoes in 2019. During the last 5 years, production has been a bit volatile. Since 2016, the production levels have been on a declining trend, as during this period most tomato producers suffered significant losses due to the crop disease "*tuta absoluta*". Sector experts indicate that this trend will improve given that there is renewed interest by the government to revive the value chain and some key investments are being made by Large companies (e.g., Dangote, Olam) and SMEs (e.g., Tomato Jos).

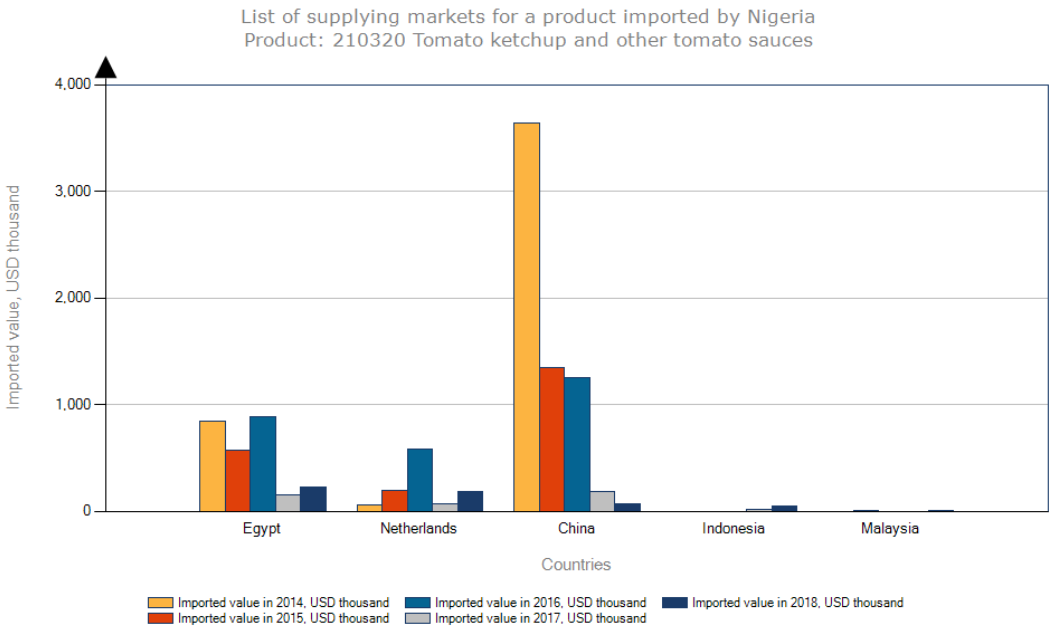
Figure 2: Production of Tomato in Nigeria (in tonnes)
(Source: Based on FAOSTAT, 2019)



FMARD (2015) estimates the demand gap for tomato as 2.3 million tonnes.[3] Nigeria supplements local demand for fresh tomatoes with USD 360 million (over 300,000 metric tonnes) of imported tomato paste annually. At

optimal production (i.e., at 0% food loss), Nigeria would register an estimated 7.1 million tonnes of tomatoes in production for 2019, thereby meeting its local demand with almost a million tonnes in excess.[4] According to ITC, the top 5 countries supplying tomato paste, ketchup and sauces to Nigeria include Egypt, Netherlands, China, Indonesia and Malaysia.

Figure 3: Suppliers of tomato paste, ketchup to Nigeria
(Source: ITC Trade Map)



SWOT for Tomato Value Chain

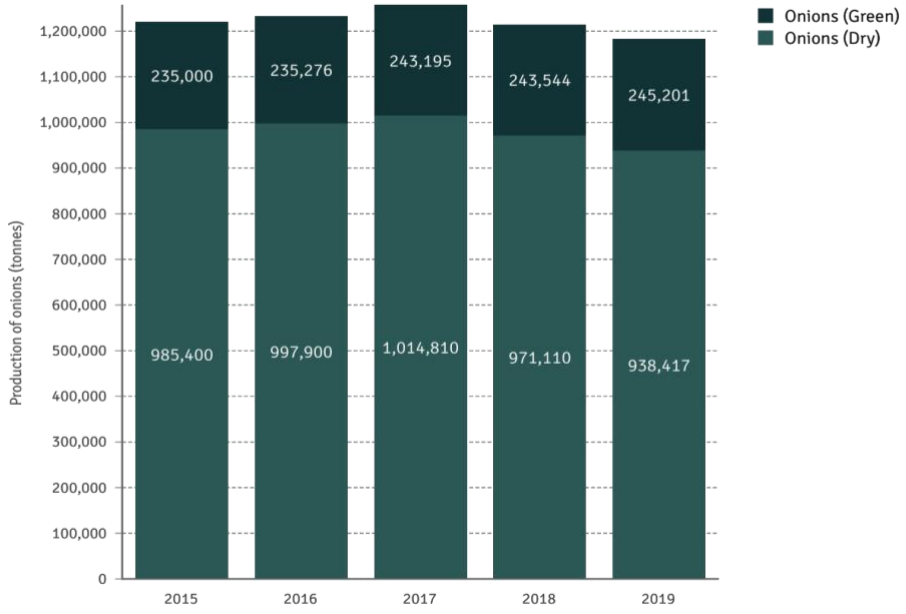
Strengths	Opportunities
• Nigeria is the 14th largest producer of tomato in the world and the second largest producer of fresh tomatoes in Africa, producing 10.8% of fresh tomatoes in the region • Government has developed a tomato policy (which is yet to be fully implemented). The policy is said to have market incentives to encourage local production and processing, and discourages importation of tomato paste, powder or concentrate. • There are already several tomato-paste and concentrate processing SMEs in Nigeria.	• Estimated potential production yield is relatively high, if the right investment is provided is about 20-25mt/ha • Possibility for local value addition – tomato paste, sauce, puree, etc. • Large domestic and regional market (unmet) demand. Nigerians consume an estimated 2.3 million tonnes of tomatoes annually, with 12kg per capita. • Possibility of mobilizing Dutch business content/knowledge/ technology in various parts of the tomato value chain • There are already some Dutch horticulture companies doing business in Nigeria. Also, the Nigerian Embassy has an existing horticulture program. • Possibilities for the application of Circular economy concept • Possibility of utilizing Railway to transport tomato products from the North to the South of Nigeria.

Weaknesses	Threats
• Low yields (5-10 mt/ha) and productivity • High susceptibility to pest/diseases and abiotic stress • Limited technologies and facilities for storage and processing • Over 80% of tomato farmers in Nigeria still cultivate tomatoes in the old and outdated ways with unproductive seeds and seedlings • High rate of post-harvest losses (particularly in-transit losses) • High dependence on fertilizers and agrochemicals /misuse of agrochemicals, use of counterfeit products • Lack of chain transparency • Poor Infrastructure • Limited access to good quality seed and input at affordable price • Insufficient access to credit facility for SMEs (particularly women-owned or led SMEs) • Nigeria imports tomato paste estimated at USD 360 million annually.	• Pest and diseases incidence (e.g. *tuta absoluta*) • Extreme weather conditions / threat of climate change • Market price fluctuations • Herdsmen encroaching tomato fields • Insecurity and armed robbery on the transport corridors for the tomato VC • Delays of delivery largely due to significant truck stoppage and extortion by police officers on the transport corridors for the tomato VC.

2.1.2 Onion

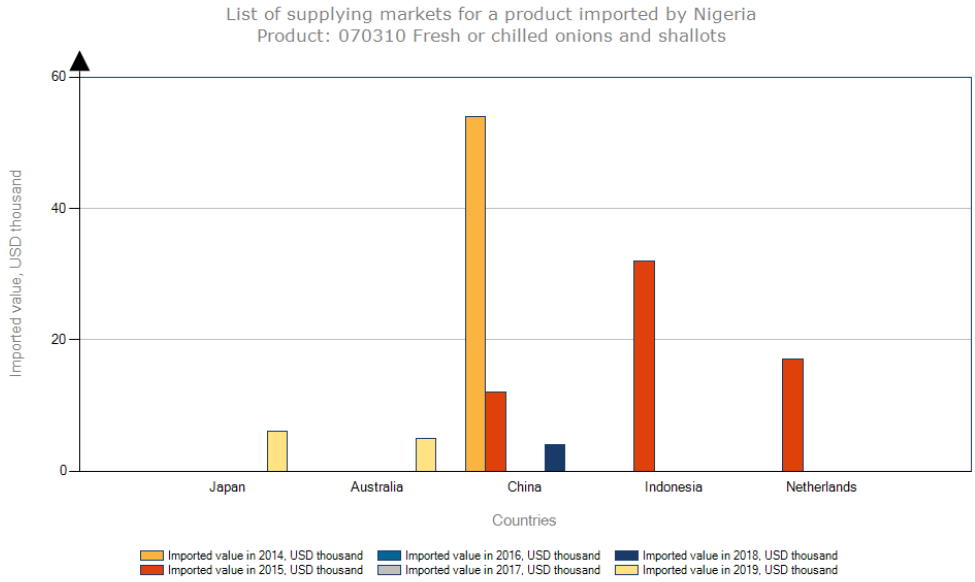
Nigeria is the largest onion producer in West Africa with a total production of slightly above 1.1 million tonnes. Onions are only produced in the northern states of Nigeria. The dominant states involved in the production of onions are Kaduna, Kano and Sokoto. Overall, during the last 5 years (i.e., 2015 – 2019), the production of onions has been largely stable. The (green) onion segment has been growing during this period, while the dry onions segment experienced a slight decline in the last 3 years. The reason for this would be explored with sector experts during the field research phase. The Onion Producers and Marketers Association of Nigeria (OPMAN) claims that the country could generate about USD 420 million annually from onion cultivation. [5] Onion farmers are faced with storage challenges, as about 50 per cent of onions harvested are lost due to poor storage system. In 2019, several farmers lost significant amounts of onion crops due to a fungal infection called Purple Blotch.[6]

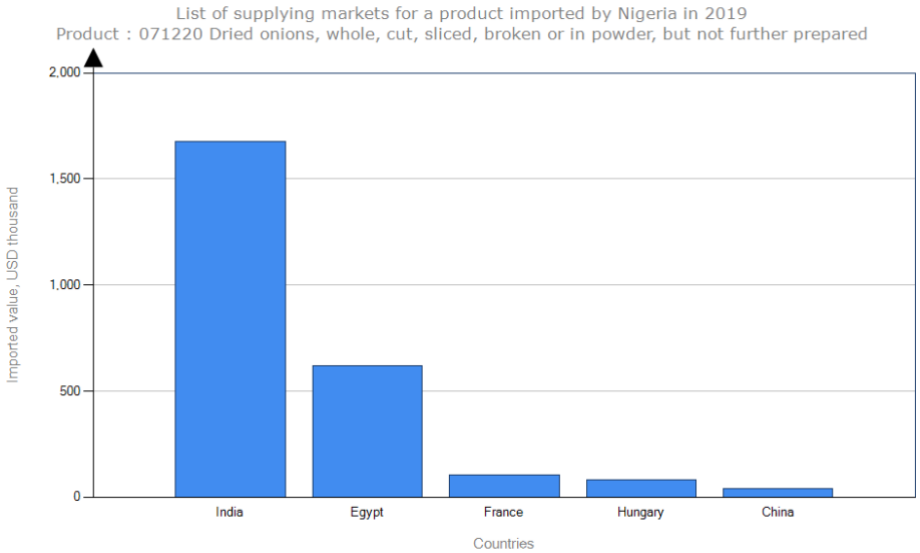
Figure 4: Production of Onions in Nigeria (in tonnes)
(Source: FAOSTAT, 2019)



Data from FMARD (2015) also shows that the demand gap for onion is around 0.8 million tonnes. At optimal production (i.e., at 0% food loss), Nigeria would register an estimated 2.2 million tonnes of onions in production for 2019, thereby meeting its local demand, with around 0.3 million tonnes in excess.[7] As of early November the prices of onions have significantly increased due to scarcity of onions on the market. There has been a 325 percent increase in the price of dry onions from an average of N20,000 (44 Euros) recorded earlier in January 2020 to N85,000 (188 Euros) as of November 10, 2020. Also, a 261.1% increase in the price of green onions from N18,000 (30 Euros) to N65,000 (143 Euros). According to an onion trader, "*Usually about 40 to 50 lorries of onions come into the Mile-12 market daily, now we barely receive 2 to 3 lorries in a day. This scarcity has also contributed to the significant hike in price*."[8] ITC Trade Map reported that Nigeria exported fresh onions and shallots only to Ghana and only in 2017 and 2018, with values of USD 460,000 and 826,000, respectively. Other sources claim that Nigerian onions are exported to neighboring Niger, Benin, Senegal, Cameroon and other countries (NBS, 2017). The country imports fresh onions from Japan, Australia, China, Indonesia and Netherlands. In 2019, the top 5 countries where Nigeria imported dried onions were: India, Egypt, France, Hungary and China. Nigeria did not export dried onions during 2014 – 2019.

Figure 5: Suppliers of Onions Fresh and Dried to Nigeria
(Source: ITC Trade Map)





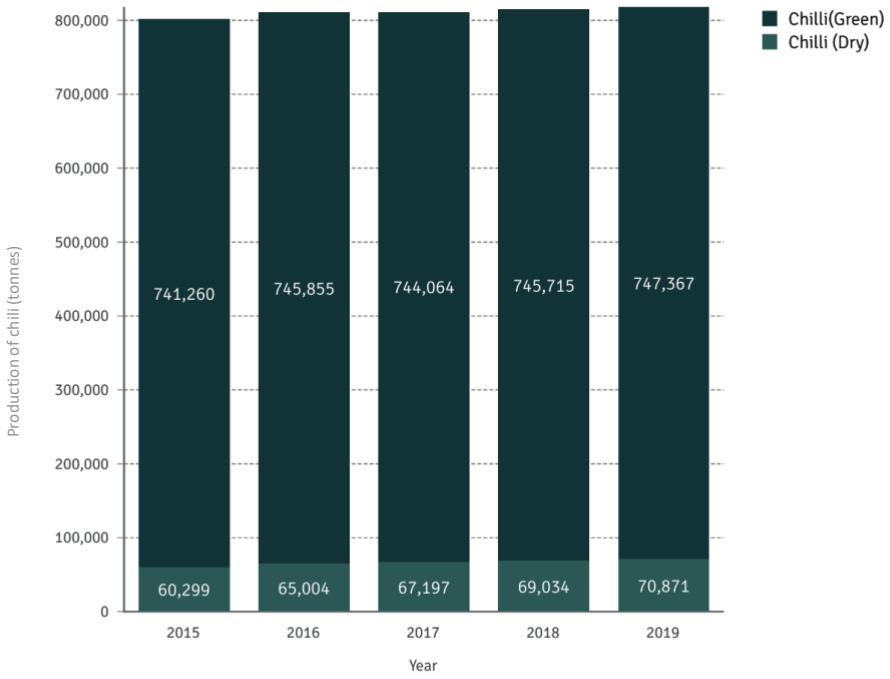
SWOT for Onion Value Chain

Strengths	Opportunities
• Nigeria is the largest onion producer in west Africa • There are already several onion processing SMEs in Nigeria. • There are already some Dutch horticulture companies doing business in Nigeria (Bejo Zaden sells improved onion seeds to Tays Nig. Ltd.). Also, the Nigerian Embassy has an existing horticulture program.	• Possibility for local value addition – onion powder, onion flakes, etc. • With value addition, about 420million USD could be realized from onion export. • Possibility of applying low-cost storage and preservation methods and facilities (e.g ZECC). • Large domestic (unmet) demand. • Possibility of mobilizing Dutch business content/knowledge/ technology in various parts of the tomato value chain
Weaknesses	**Threats**
• Farmers are highly financially dependent on onion traders particularly for input (seeds and fertilizers) • The fact that there is one main season with harvest in April – May resulting in an enormous peak in supply. • A nearly complete lack of storage possibilities to store this peak and spread the sales over a long period • Insufficient financing possibilities makes it difficult for farmers to invest in better growing techniques and storage facilities • The production is still mainly small scaled and locally organized, not suitable for large scale nationwide distribution and trade • Most onion farmers still lack knowledge of GAP • High rate of post-harvest losses (particularly in-transit • Limited access to good quality seed and input at affordable price • Insufficient access to credit facility for SMEs (particularly women-owned or led SMEs)	• Pest and diseases incidence (Fungal infection incident: *Purple Blotch*, caused severe crop destruction in 2019) • Extreme weather conditions / threat of climate change • Market price fluctuation. Currently, Onions is scarce in Nigerian local markets and extremely expensive. To the extent that alternatives to onions are being sought. • Insecurity and armed robbery on the transport corridors for the onion VC • Delays of delivery largely due to significant truck stoppage and extortion by police officers on the transport corridors for the tomato VC.

2.1.3 Chili

As noted earlier, Nigeria is the 7th largest producer of chili peppers in the world. Peppers are produced in more than 80% of Nigeria. Most peppers (36%), tomatoes (43%), and onions (50%) are produced in Kaduna and Kano States.[9] Chili production volume is around 818,000 tonnes. It has grown steadily over the last 5 years. Sector experts predict that this trend will continue, because in 2018, the sector got a boost from a new species, yellow pepper (locally called Ose Nsukka - meaning Nsukka pepper) which is said to grow only on Nsukka soil in the Northern zone of Enugu state. This species of pepper is now highly sought for by buyers all over the country. The farmers in Nsukka recently got a boost from the Central Bank of Nigeria (CBN) as the nation's apex bank shortlisted 600 of them for its agricultural loan scheme.[10]

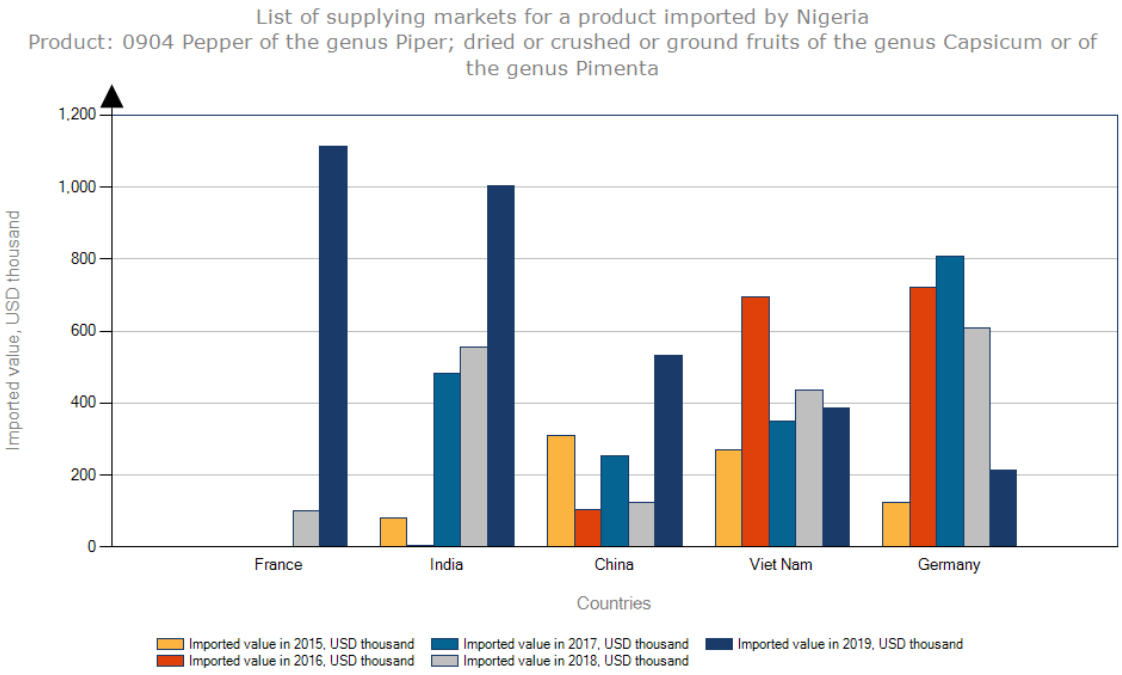
Figure 6: Production of Chili in Nigeria (in tonnes)
(Source: FAOSTAT, 2019)



Graph created based on FAOSTAT

The top 5 markets which supplied Nigeria with chili pepper (both fresh and dried) are: France, India, China, Vietnam and Germany.

Figure 7: Suppliers of Chili to Nigeria
(Source: ITC Trade Map)



SWOT for Chili Value Chain

Strengths	Opportunities
• Nigeria is the 7th largest producer of Chili in the world. • A new species was discovered, yellow pepper (locally called *Ose Nsukka* - meaning Nsukka pepper) which is said to grow only on Nsukka soil in the Northern zone of Enugu state. This species of pepper is now highly sought for by buyers all over the country. • There are already several SMEs that add value by processing Chili into chili powder. • Can be intercropped/ in crop rotation with tomato and onions	• 600 farmers of Nsukka yellow pepper species have been shortlisted to benefit from the Anchor Borrowers Program of the Central Bank of Nigeria. • Chili can be cultivated with less capital and inputs (e.g., fertilizers, pesticides) relative to land area. Due to a decrease in inputs per land area, the pressure on the environment may be decreased • There is availability of improved chili seed varieties and cultivation technologies (although not yet mainstreamed or commercial) • Chili is well adaptable in all agro-ecological zones in Nigeria. • There is both domestic and export potential for chili. The demand for chili in Nigeria is not met, yet there is also international export demand. Nigeria's chili pepper attracts premium given its pungency level. It can be rapidly dried, grounded and packaged for export. • Industrial uses in preparing topical creams meant for lessening pains, inflammations and itching, green chili extract used as bioinsecticides • There is possibility for year-round production with irrigation.
Weaknesses	**Threats**
• Low yields and productivity • High susceptibility to pest/diseases and abiotic stress • Limited technologies for drying. • High rate of post-harvest losses (about 20-30%) • High dependence on fertilizers and agrochemicals • Poor Infrastructure • Limited access to good quality seed and input at affordable price • Insufficient access to credit facility for SMEs (particularly women-owned or led SMEs)	• Pest and diseases incidence • Extreme weather conditions / threat of climate change • Market price fluctuations • Insecurity and armed robbery on the transport corridors for the chili pepper VC • Delays of delivery largely due to significant truck stoppage and extortion by police officers on the transport corridors for the tomato VC.

2.2 Food Loss in Nigeria and Dutch Policy Perspective

Food Loss can be defined as the decrease in edible food mass that takes place at production, post-harvest and processing stages in the value chain, before it reaches the consumer (Vilariño et al, 2017). To distinguish, Parfitt et al and Lipinski et al (2013) define Food Waste as food that is of good quality and fit for human consumption but that does not get consumed because it is discarded at the end of the food chain (i.e., Distribution and consumption. [11]

For most countries in Sub-Saharan Africa, such as Nigeria, the issue of food loss represents a wastefulness of limited natural resources that potentially triggers food and nutrition insecurity and exacerbates poverty. According to research by FAO (2015), about 690million people are hungry, representing 8.9 percent of the world's population (this number is estimated to rise to 890million and 9.8 percent of global population by 2030 and depending on the economic growth scenarios, FAO estimates that between 83 and 132 million more will be undernourished globally). *In 2019, close to 750 million – or nearly one in ten people in the world – were exposed to severe levels of food insecurity*. Studies have shown that decreasing food loss (and waste) contributes to reducing global hunger and food insecurity and to ensuring food safety and nutrition, particularly in developing countries where the most amount of people are considered hungry, food insecure and malnourished.[12]

FAO estimates that the direct economic cost of food wastage (including food losses) is around USD 1 trillion/year (excluding the cost of social and environmental externalities). Research also shows that food loss triggers significant economic loss when one accounts for the time invested in the production and supply chain, as well as in land preparation, the use of fertilizers, and other costs involved in agricultural production.[13]

Food loss can also exacerbate poverty particularly in developing countries like Nigeria. Studies indicate that a decrease in the quality of food products can lead to a decrease in the quantity available for sale and consequently a decrease in economic gain, especially for millions of smallholder families and low-income farmers in developing countries. According to the World Bank (2013), in Sub- Saharan Africa, a one percent reduction in postharvest losses could save $40 million each year, which could be used in alleviating other facets of poverty. Reducing post-harvest losses could increase income for 470 million smallholder farms world-wide, representing a big step forward in global efforts to end poverty and contribute to food security and sustainability. For this reason, as part of the recent commitments, the African Union (AU) Heads of State and Government committed to ending hunger by 2025 and to achieve this, they further resolved to halve the current levels of post-harvest losses by the year 2025.[14]

Nigeria generates some 32 million tonnes of waste per year (including all stages of the value chain). Intervention in the three VCs identified presents an opportunity to support Nigeria in addressing SDG 12 (12.3) "...*reduce food losses along production and supply chains by 2030*". Next to this, there is significant potential for job creation for millions of Nigerian women and youth, as the production, processing and trade of tomato, chili and onions in Nigeria is dominated by women and youth. For example, the Nigerian Government believes that if correctly implemented, a policy that targets increased local production of fresh tomato fruit consumption and processing could curb 40 percent of tomato wastage and create 60,000 direct employment.[15]

Food Loss is still a big challenge for Nigeria due to various reasons. Most of the VCs that contribute significantly to food loss (e.g., tomato, onion and Chilli) are not well developed (or advanced) and organized in terms of production and processing techniques, equipment, technology and governance. Furthermore, there is poor enabling policy environment to catalyze development of the VCs. Chain supporters and influencers in Nigeria have not taken a holistic view when proposing interventions or solutions to tackle this issue. To address food loss in Nigeria, there needs to be concerted effort (supporters and influencers) and a holistic strategy. For instance, intervention to curb food loss in Nigeria should include action on all of the following, amongst others:

- Financial support to improve roads, energy infrastructure as well as the machinery used in the VCs,
- Institutional arrangements and reforms to facilitate access of private sector investment for improved production and value-added processing in the VCs,
- Introducing government actions and policies to discourage food loss,
- Circular economy approach: focus on the causes of food loss as well as the consequences, regional and country differences; ideas and solutions as well as the stakeholders and actors involved, and
- Communication and education campaigns targeted to reduce food loss particularly at farm level, processing sites as well as during transport and distribution.

Even on the level of the individual VCs, the government appears ineffective in implementing measures that might strengthen the VCs and curb losses. For instance, it is widely known that Nigeria imports tomato from other countries because it cannot meet its domestic demand, largely due to losses and wastages. It is said that this has created a situation where Nigeria has become a dumping ground for tomato fresh, paste, juice and concentrates from countries such as Egypt, Luxemburg, Cameroon, Italy, South Africa, the Netherlands, and Iran. In fact, in July 2019, the Nigerian Customs Service, announced that it had seized six containers of "poisonous tomato paste" (expired and low-quality tomato paste) from Iran, at the Nigerian Ports.[16]

In 2019, the Tomato Growers Association of Nigeria (TOGAN), stressed that their members are losing around 40 percent of their total annual production. It was also reported that in 2018 tomato farmers lost over USD 10 billion worth of produce, due to poor market and lack of guaranteed off-takers.[17] There have been calls for the Federal Government of Nigeria to start implementing the Tomato Policy which it outlined in 2017 (three years on). This policy is expected to "encourage local production and processing by increasing the tariff on importation of tomato concentrate to 50 per cent alongside an additional levy of USD1,500 per mt." The policy classifies "greenhouse equipment as agricultural equipment in order to attract zero per cent import duty"; stops "the importation of tomato paste, powder or concentrate put up for retail sale"; stops "the importation of tomatoes preserved otherwise by vinegar or acetic acid"; restricts the "importation of tomato concentrate to the seaports to address the abuse of the ECOWAS Trade Liberalization Scheme (ETLS)"; and includes "tomato production and processing in the list of industries eligible for investment incentives administered by the Nigeria Investment Promotion Commission (NIPC)."[18] Yet, the tomato policy is not being implemented fully.

Importance for Dutch policy perspective: Nigeria is one of the priority countries for the Dutch government's aid for trade development cooperation policy. This has been underlined by the 2018 policy note 'Investing in global prospects'.[19] But also, the Dutch private sector has interest in Nigeria. VNO-NCW in its 2019 Africa strategy mentions Nigeria as the biggest economy on the continent and one of its 3 target countries on the African continent. Within Nigeria, agriculture and food & nutrition security are priority sectors for Dutch interventions. Food loss and waste is one of the SDGs (SDG 12: 12.3) which the Netherlands intends to address. As mentioned earlier, addressing food loss can provide gains on global food and nutrition security and the fight against poverty in countries like Nigeria. Furthermore, there is opportunity to bring Dutch content especially through the following (*Some of these are elaborated in section 5.2: Interventions*):

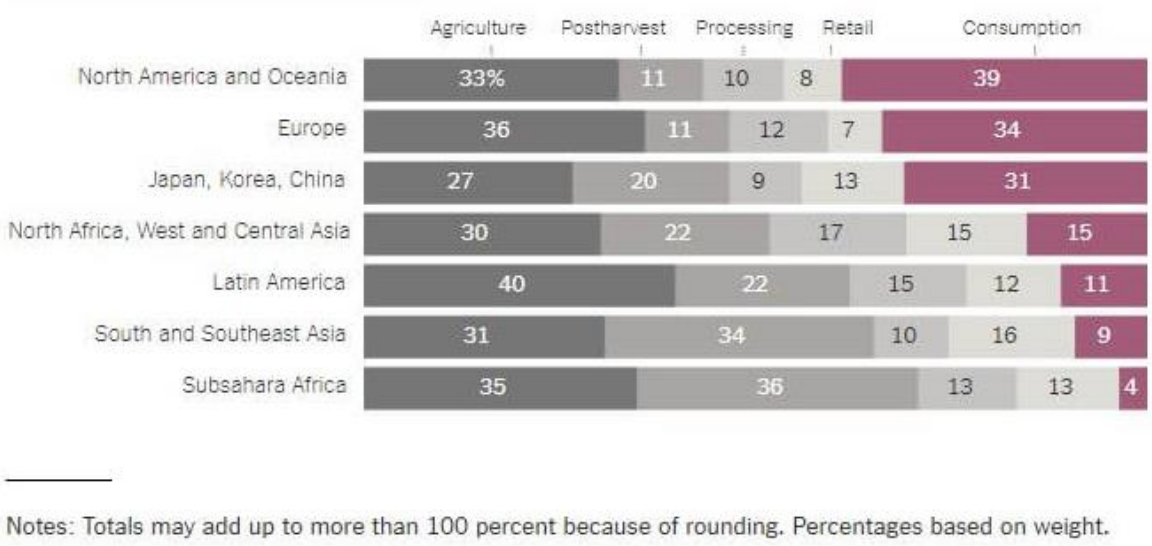
- Knowledge transfer, seed and equipment supply and access to finance, transparency, marketing logistics, cold chain.
- Facilitate the use of some existing Dutch financial instruments in supporting the necessary infrastructure to combat food loss.
- Opportunity for Dutch knowledge on 'modern' greenhouse.
- Opportunity to apply Dutch knowledge and experience on Circular Economy in tackling food loss (and waste).

2.3 How and where food is lost in Tomato, Onion and Chili VCs

According to the New York Times, in Sub Saharan Africa, food is lost at the rate of 35 percent during production, 36 percent during postharvest, and 13 percent during processing. See figure 2 below.

Figure 8: How Food is lost by Region

(Source: New York Times, UN Food and Agriculture Organisation, 2017)[20]



Notes: Totals may add up to more than 100 percent because of rounding. Percentages based on weight.

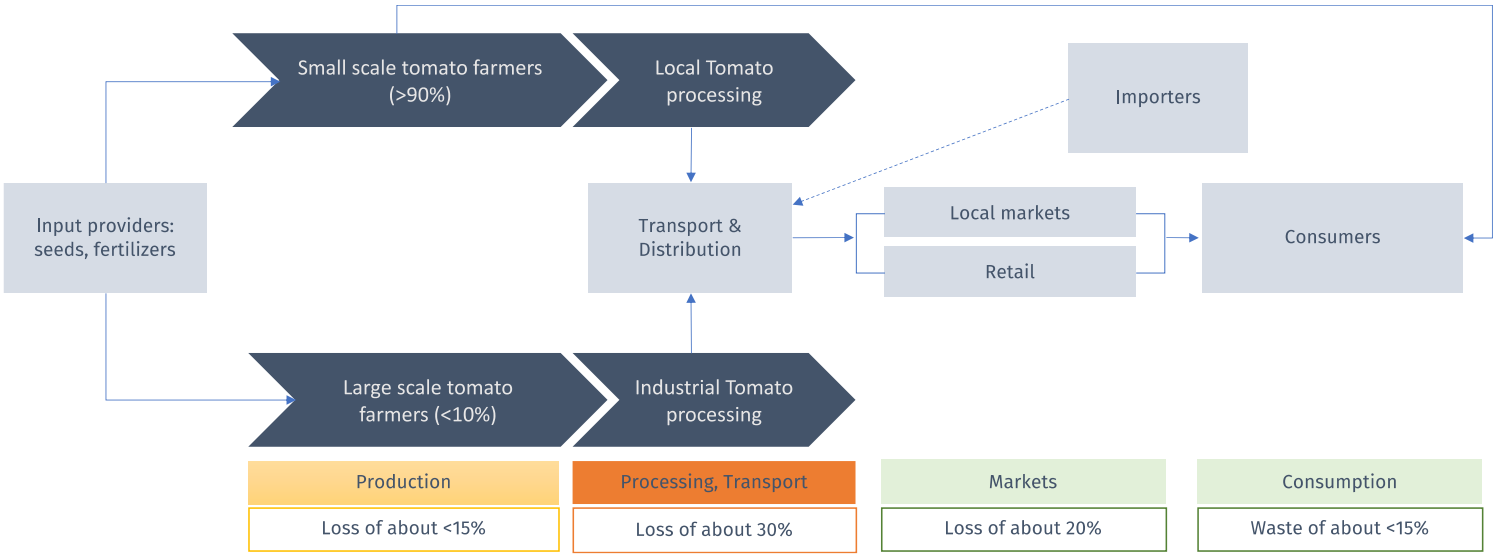
Tomato VC

Tomato is a major food component consumed in every Nigerian household. Nigeria is one of the largest consumers of the vegetable in Sub-Saharan Africa with about 22 kg per capita. Tomato accounts for about 18 percent of the average consumption of vegetables in Nigerian daily diets. Nigeria is also the 14th largest producer of tomato in the world and the 2nd largest Tomato producer in Africa, with an average of 3.9 million tonnes per production (FAO, 2014-2018). Nigeria has an average yield 6.19 ton/ha (FA0, 2014-2018), compared to the world's average of 38.1 ton/ha and Europe which has an excess of 100 ton/ha. Similarly, Nigeria is the 13th the largest importer of tomato pastes in the world and the 2nd largest importer of tomato paste in Africa. There is potential for export of tomato products to other regions, but the local demand for tomato is largely unmet, in part due to poor post- harvest practices. High postharvest losses and lack of processing and marketing infrastructure are challenges that restrain an efficient tomato value chain. This is evident in Nigeria. In 2016 the tomato VC suffered from the disease '*Tuta absoluta*,' locally known as 'Tomato Ebola,' which spread through tomato farms rapidly and unnoticed, causing severe crop damage.

Researchers provide different amounts for tomato losses in the entire value chain. However, sector experts estimate that the annual losses of tomatoes in Nigeria is between 45 – 60 percent of the total production. An estimated breakdown based on existing research is shown in the illustration below. It is estimated that food loss during production can be as much as 15 percent,[21] and 30 percent during harvesting, processing, packaging, transportation and distribution and 20 percent at the markets.[22]

Figure 9: Where Food is lost in Tomato Value Chain

(Source: Based on FAO, GEMS4, PwC Analysis, World Vegetable Center, etc.)[23]



Onions VC

Onions are important vegetable crops grown mainly as food materials for domestic consumption and export in most part of the world particularly the varieties that are grown for bulbs. In terms of global weight of vegetables produced only tomatoes and cabbages exceed bulb onions in importance. Onion is highly valued for their flavor, nutritional value and herbs because of their richness in vitamins (such as vitamins A and C), protein, minerals, and fiber. Onions have interesting properties which makes it ideal for culinary use, but also for therapeutic purpose. Onions are important vegetables used in preparing local soups and stews, therefore it is widely consumed. It is also considered an herbal remedy for colds, coughs, bronchitis, anemia, cholera, influenza, disorders of urinary system and bleeding piles.

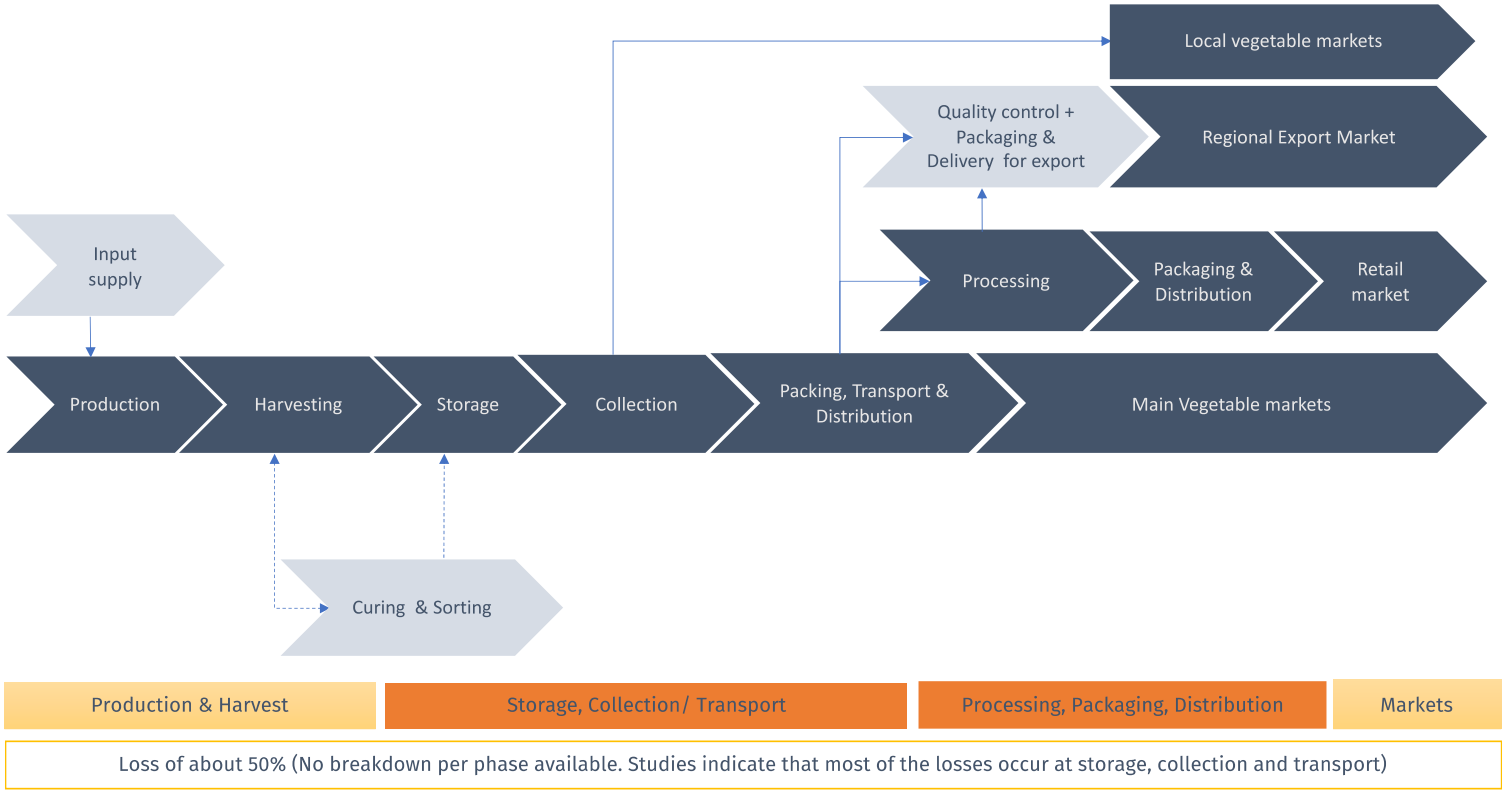
Onion is grown in at least 175 countries (FAO) with China and India as the primary onion growing countries. Nigeria is the largest onion producer in West Africa with a total production of more than 1 million tons, exporting to neighboring Niger, Benin, Senegal, Cameroon and other countries. In Nigeria. The crop is one of the most important sources of income for smallholder farmers, women, and youth, particularly in the northern part of Nigeria. Onion is grown mostly in Kano, Kaduna, Jigawa, Sokoto, Plateau, Bauchi and Kebbi States, in several varieties (e.g., Red and White Creole, Bombay Red, Tropicana Red (F1 Hybrid) and Green Bunching).

Although onion is considered as a semi perishable crop, it is also a delicate product to store due to its high-water content. Depending on cultivar type and pre harvest as well as post-harvest treatments, onion bulbs can be stored at low temperature as 0-5°C or high temperature (25-30°C) maintaining the relative humidity in the range of 55%-70%. Onion requires to be stored properly to prevent it from decay. Unfortunately, farmers have only 3 months to harvest onions for a year-round supply. The raining season picks up almost immediately after harvesting. If the onions are not properly protected, they will become rotten in the field by June.[24]

It is estimated that up to 50 percent[25] of onions are lost at post-harvest due to poor storage and post-harvest handling practices. Below is a table that shows the main causes of post-harvest losses in the onion VC as identified in a survey of more than 250 onion farmers in three major onion producing communities in Kano state Nigeria.[26] The onion farmers indicated that *inadequate storage and processing facilities* is the main bottleneck and the key cause of post-harvest loss in their communities. They incurred significant financial losses due to this. Some of the participants revealed that, during the year, they could only effectively store about one third of their fresh onions and as a result they sell immediately after harvesting at farm point at cheaper rates, than normal. The high rate of post-harvest loss in the area necessitates the onion farmers to adopt various local methods of storing, such as local store (*Rumbu*), top of the roofing, use of basket, hanging method, spreading on the floor and spreading under tree.

Figure 10: Where Food is lost in the Onion Value Chain

(Source: Based on World Vegetable Center, [27] Onion Producers and Marketers Association of Nigeria, FMARD, etc.)



Chilli VC

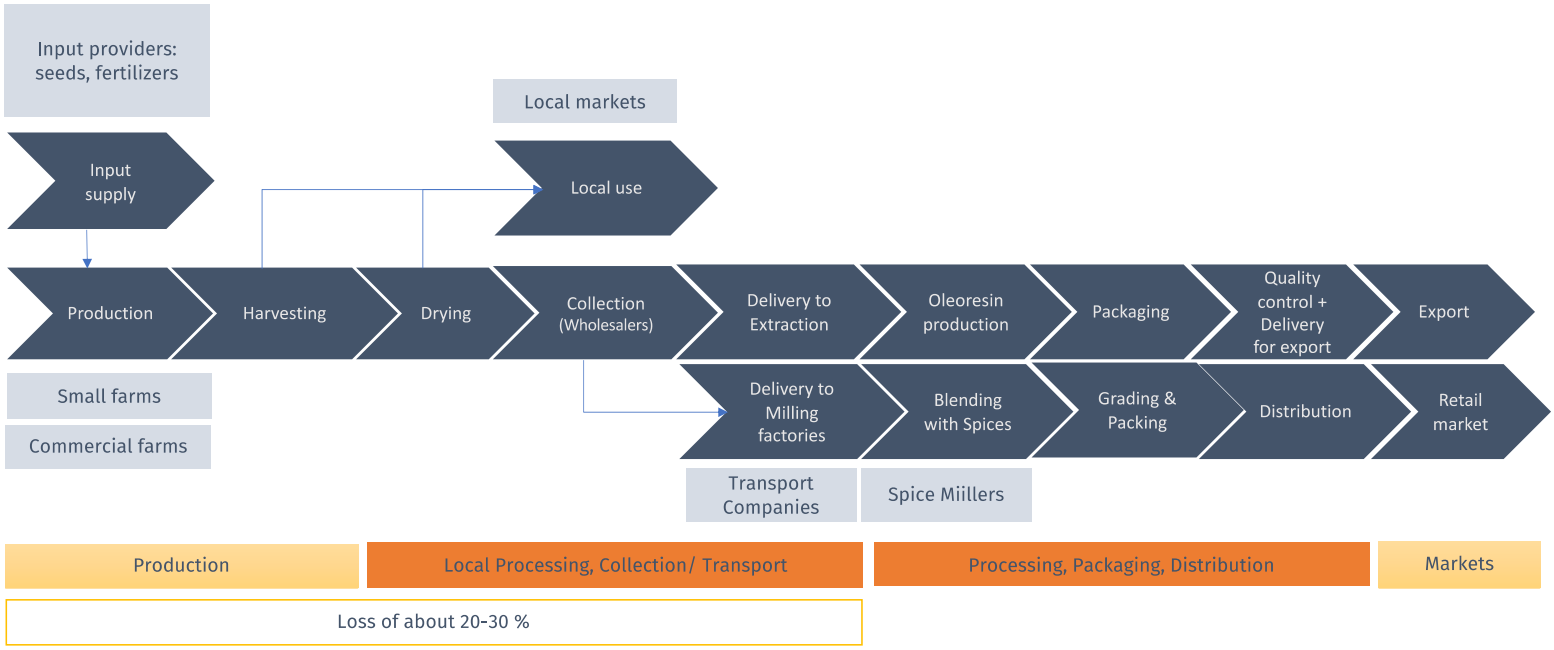
Nigeria is the 7th largest producer of chili and pepper (green) in the world. It is grown in more than 80 percent of the states in the country. The indicative production yield is around 7.6 kg/ha. This is in line with average yield in West Africa. The two major pepper species grown in Nigeria are capsicum annuum (bell pepper,

cayenne, chili) and capsicum frutescens (elongated chili or bird chili). The types of pepper suitable for commercial production in the country are the large fruited sweet pepper, the medium corrugated fruited hot pepper, and the small- fruited chili/red pepper. Most of chili pepper production is done by smallholders. Some of the known benefits of chili pepper are: Chili is used as a spice in many dishes to add flavor and color. It is also used to provide relief for several ailments. It can be found in topical creams that are intended to reduce muscle pain, inflammation and itching. Chili can act as a heart stimulant which regulates blood flow and strengthens the arteries, possibly reducing heart attacks. It has soothing effects on the digestive system, offers relief from symptoms of colds, sore throats and fevers, circulation, especially for cold hands and feet, and as a hangover remedy. Fresh peppers are important vitamin sources. It can be used to regulate blood sugar. Hot chili peppers are considered potent in fighting prostate cancer. Losses in chili value chain is estimated to be around 20-30 percent. [28] Some studies have noted that the losses are most often caused by microbial infection, physiological breakdown due to natural ripening processes and environmental conditions such as heat, drought.

Furthermore, wastages occur due to improper postharvest sanitation, poor storage and packaging practices and damage during harvesting, handling and transportation resulting from vibration by undulation and irregularities on the road.

Figure 11: Where Food is lost in the Chili Value Chain

(Source: Based on Olayemi F., et al (2010), [29].)

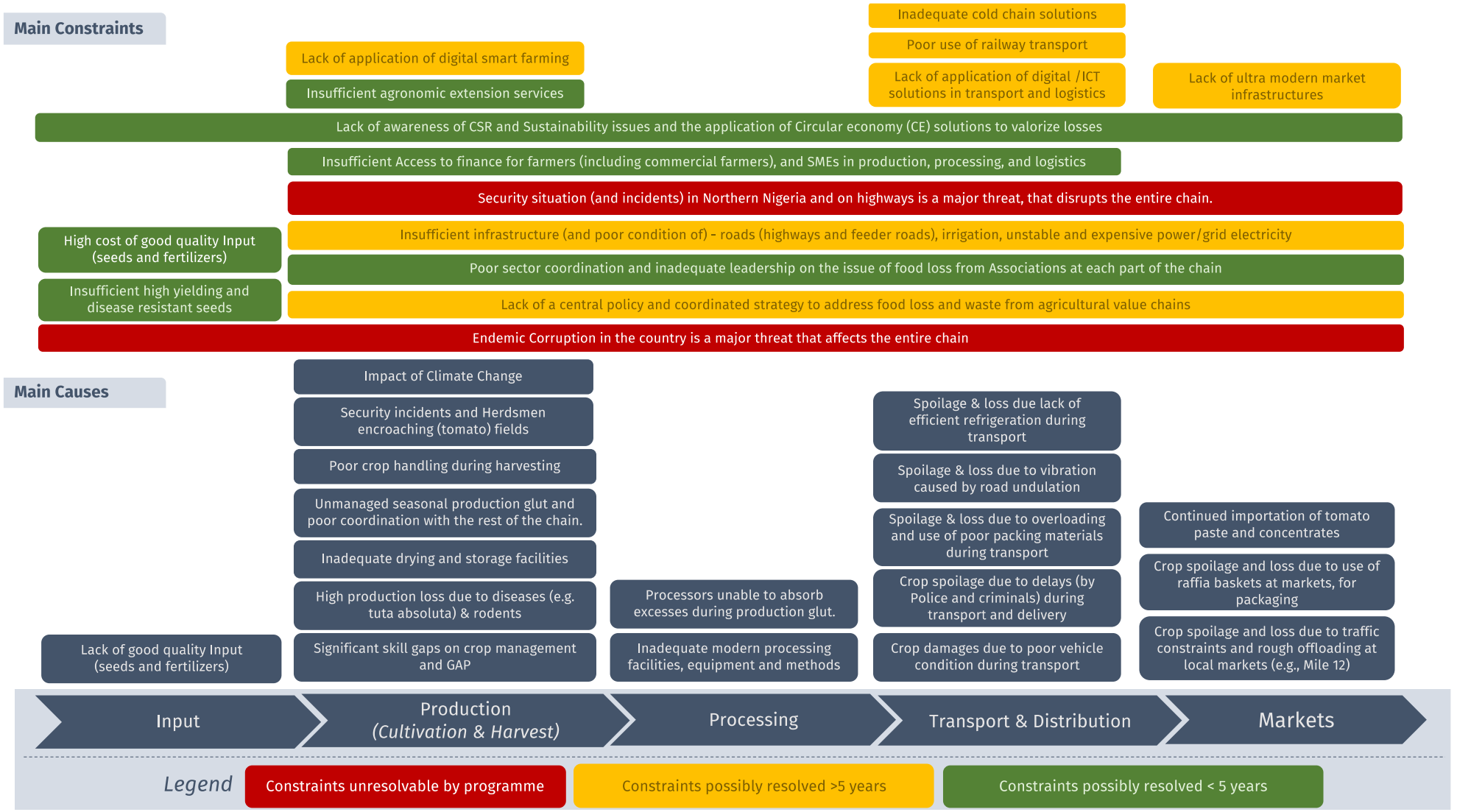


2.4 Main Causes and Constraints of Food Loss in Tomato, Onion and Chili VCs

This section highlights a summary from existing research, of the main causes and constraints raised by tomato actors in both South Western Nigeria (Lagos and Oyo) and North (Kano, Kaduna);[30] a survey of more than 250 onion farmers in three major onion producing communities in Kano state Nigeria;[31] and 120 small scale farm holders of tomato, bell and hot pepper in four local government areas of Kano State, Nigeria.[32]

Figure 12: Summary of main causes and constraints in tomato, onion and chili VCs

(Source: mapping developed by authors based on input from study participants and literature)



2.4.1 Input and Production (Cultivation, Harvest)

Below is a description of some of the causes and constraints of food loss in the tomato, onion and chili value chains.

a) **Lack of good quality input (seeds and fertilizers)**: One of the main causes of food losses in the three value chains is the fact that farmers lack good quality seeds, fertilizers and agrochemicals. For instance, according to Technoserve (2020), around 80 percent of tomato seeds planted by farmers are generic varieties which are of low quality and with limited post-harvest shelf-life.[33] World Vegetable Center maintains that in the onion VC, losses begin with the smallholder farmer's choice of seeds, noting that based on their experience, onion farmers in Sokoto typically cultivate local landrace varieties, that produce onions with low shelf-life.[34] In several existing studies, farmers in the three value chains indicate that there are good seed varieties and fertilizers on the market but, that they are not affordable to smallholder farmers. There is also the constraint of lack of access to credit facilities for small farmers, which make it challenging for them to purchase good quality input. In Nigeria, banks lend only 4 percent of their portfolio to Agriculture,[35] and mostly to commercial farming or large SMEs. It is said that smallholder farmers in the vegetable sector are sometimes provided with fake inputs, which ultimately affects product quality. Additionally, agro-chemical dealers in Nigeria are said to have poor knowledge of the products that they sell to these farmers and as such are unable to provide vital product advice in terms of best treatment timing and applicable portions.

b) **Low skills on crop management and GAP**: Tomato, onion and chili smallholders in Nigeria have low skills on GAP, crop management and handling during and after harvesting. Training and capacity building in these areas is crucial for increasing product yield and curbing losses and wastages at production and harvesting stages. According to the 2Scale2 Project, training is key for improving onion farmers' postharvest practices and ultimately curbing food losses at the production and harvest stages. 2Scale notes that based on their experience in Sokoto's onion sector, "poor irrigation, lack of information on proper fertilizer formulation, and other gaps in farmers' knowledge reduce onion quality and yield". The project also stresses that onions will most certainly rot and go to waste with poor practices such as harvesting immature onion bulbs, drying onions in open fields, "exposing the bulbs to sunscald or sunburn", and poor skills and methods for storage. [36] There is also the constraint of insufficient extension services to support smallholder farmers with GAP. In Nigeria, the provision of agricultural extension services is limited due to insufficient and untrained public extension services agents. The current ratio of extension agents to farmers in Nigeria is between 1:5000 and 1:10 000. Only about 7,000 public extension agents currently exist in the country.[37] The recently established N-Power Agro programme expects to employ thousands of volunteering young graduates as extension advisors to support the country's growing need for Agric-extension support.[38]

c) **Diseases, Pests and Rodents**: In Nigeria, there are frequent pest and disease outbreaks in the tomato, onion and chili value chains, which lead to significant losses of harvest. This is compounded by the fact that access to disease-resistant seed varieties in Nigeria's vegetable sector is poor. Also, smallholder farmers often lack the knowledge of pest and disease control. In 2015/2016, the tomato sector in Nigeria had significant losses due to devastating attack of the pest *tuta absolut*a. It is said that up to 80 percent yield was lost due to the disease.[39] In 2018, scientists from the National Horticultural Research Institute in Ibadan (Nigeria) mapped the distribution of *tuta absoluta* and found that the pest is established in 360 of the 528 locations investigated around the country.[40] The impact of rodents is also important to stress. For instance, in a recent survey (Salisu et al 2020) of causes of postharvest losses expressed by 254 onion producers in Kano state, it was revealed that almost a third of the farmers attributed losses to animals (rodents, rat)/ Insects) attacks, leading to significant product losses.[41]

d) **Poor coordination with the rest of the chain and Unmanaged seasonal production glut**: Coordination and representation with the rest of the value chain is often the responsibility of sector associations and cooperatives. Tomato, onion and chili have active associations with clear governance structures including management roles and responsibilities. They are recognized by government institutions and are active in influencing government initiatives in the sector. However, according interviewees, one of the main sector constraints is that associations still have a lot to learn when it comes to providing effective coordination with other chain actors, marketing and service delivery for their members.

Interviewees specifically mentioned that associations lack knowledge and skills to provide effective training and coaching on dealing with on-farm and post-harvest losses, literacy skills on proper financial management, skills for defining a strong business model, crop planning as well as marketing, particularly in anticipation of seasonal glut, and lack of strong skill set to market their value chains to off-takers.

According to a study conducted by WUR (2019), the vegetable value chains in Nigeria are highly organized but are informal when it comes to making agreements and arrangements between value chain actors. This often leads to poor planning and management of seasonal production or market glut. In Nigeria, the tomato, chili pepper and onion value chains experience market glut (i.e., when the supply exceeds demand, and which usually results in a significant drop in price) at specific post-harvest periods. But without proper planning and coordination, good market intelligence, good storage facilities available, efficient transport and delivery system and strong off-take links with processors and exporters, farmers usually either dispose of their produce or sell them at substantially low prices.

e) **Poor crop handling and storage during harvesting**: As illustrated earlier, (see (b) above), lack of technical know-how on crop handling during harvesting often leads to losses. Further, the lack of effective (drying and) storage facilities upstream in the value chain and at the local markets lead to crop spoilage and losses. Most farmers use rudimentary storage techniques and facilities which are often inadequate to preserve tomato, chili and onions when harvested (drying on floor, using *Rudu*, etc.). For instance, studies have shown that drying tomato or chili on the floor instead of (raised solar drying platforms) produce significantly lower quality tomatoes with contamination by dust and sand, and a lower price margin compared to raised solar drying.[42] Also, according to the World vegetable center, Nigerian onion producers use the *Rudu*, a local straw structure used for onion storage. It is said that the local structure can store onion up to six months; however around 50 percent of the onions stored with the Rudu decay or shrivel because onion farmers do not grade or sort the harvested onions before storing in the facility. “Diseases quickly spread to the entire lot if the *Rudu* is not carefully monitored and decaying, moldy onions promptly removed. Sprouting and the growth of bacteria occur when temperatures in the *Rudu* are too high, and when more than three levels of onions are stacked together, preventing sufficient aeration of the bulbs at the base”.[43] Poor crop handling and storage during harvesting is exacerbated by the constraint of lack of access to credit facilities for small farmers, which inhibits them to invest in better storage facilities and upgrading their technical knowledge.

f) **Security incidents**: Smallholder farmers stress that security incidents and recent outbreaks of violence especially in the Northern part of Nigeria, cause disruptions and ultimately lead to on farm and post-harvest losses in the three value chains. In particular, cases highlighted include herdsmen encroaching tomato and onion fields,[44] and insecurity and armed robbery during highway transit and supply corridors.[45] When these incidents occur, products in the fields are often abandoned, and sometimes, packed produce in trucks are damaged or destroyed, leading to losses.

2.4.2 Processing

a) The main causes of losses in the processing phase of these value chains are that Nigeria still has insufficient modern processing facilities, and processing equipment and methods in use are still rudimentary. Only very few companies active in processing tomato, chili and onion have large factory processing capacities (see examples in section 3.2). This makes it challenging for processors to off-take high amounts of products during peak seasons (or absorb excesses during seasonal glut). At the same time, processing factories require adequate and consistent supply of produce, but the high amounts of production losses result in limited supply of, thereby discouraging processing. For instance, according to PWC (2017), in recent years, many processing factories have closed down mainly due to unavailability of fresh tomatoes.[46]

During the interviews and validation session, participants (particularly Dangote and Easy Sauces) stressed that investments to support SME processing companies to improve their factory capacities is crucial to combat food loss effectively. Other participants expressed the need for government intervention in the form of policy instruments to boost processing activities in the three value chains. The Tomato policy was raised as an example of a potential policy instrument (if optimally

implemented) that could incentivize the processing of tomato in Nigeria and reduce the dependence on foreign imports for tomato paste and concentrates.

2.4.3 Transportation & Distribution

a) **Poor condition of vehicles used during transport, overloading of trucks and the use of poor packaging materials (such as raffia baskets) during transport is a major cause of food loss at this phase of the value chain.** Stacks of tomato, onions and chili can easily be seen in raffia baskets loaded in open trucks often packed in overcapacity, being transported on Nigerian highways (on the product trade corridors); with some falling off in transit. At times, inappropriate vehicles (such as fuel tankers), old open trucks with poor engine conditions and passenger taxis are used for transporting significant amounts of the products. The poor vehicle conditions add to the delays incurred by transporters, which affect the quality of the products. Bruises or damages resulting from compression suffered by these fresh produces reduce the marketing quality and as such are either sold for cheap or destroyed. Besides, dangerous truck overloading is noted by the Nigerian Federal Road Safety Commission as a key factor accounting for accidents and deaths, among truck drivers on Nigerian roads.[47]

b) **Delays by police and customs during long distance transit**: Extortion on the highways (by police and customs) lead to significant delays for transporters of perishable goods, who need to move them as quickly as possible to their final destinations. Police and Customs personnel are said to set up official and unofficial checkpoints or roadblocks at numerous points along key corridors of the three value chains. Each checkpoint stop creates unnecessary traffic delays, leading to significant loss of time and money for transporters. It heightens the uncertainty around product delivery and increases product spoilage. These government security forces request bribes or "fees as unofficial payments required for passage, as opposed to genuine state-sanctioned levies". A World bank (2015) report indicates that for the Kano–Lagos corridor (which is a crucial road network for the tomato, onion and chili value chains), "only about 60 percent of the total travel time is spent driving. Holdups, including roadblocks, account for over 20 percent of the total" and the fees charged by these government forces along the kano-Lagos constitute "nearly 40 percent of the costs incurred by transporters".[48]

c) **Poor road condition during transportation:** Nigeria is said to have the largest road network in West Africa, with about 195,000 km of road network. However, as of 2019, only about 31 percent (or 60,000 km) are paved. The condition of most roads in the country are poor, mainly due to lack of consistent maintenance, and the use of poor-quality materials both during construction and repairs. Some parts of transit corridors that are important for tomato, onion and chili trade (particularly North to South) are almost impassable due to excessive potholes and uneven surfaces. The road conditions are worsened during the rainy season.

d) **Lack of efficient refrigeration during transport**: In Nigeria efficient cold refrigeration is almost nonexistent in farms, marketplaces and during transport.[49] There is lack of access to large, refrigerated warehouses and efficient cold chains to maintain fresh fruits and vegetables to their points of sale. This leads to spoilage (or rotten) products which are either sold for pittance or in many cases discarded. Due to the hot temperature in Nigeria, farmers often cover their produce with leaves during transport. However, this does not provide the needed level of cooling that is required to keep the products fresh until their points of sale. APM Terminals, Naija Pride and Technoserve are working together on providing Cold Chain solutions (Refrigerated Truck Transport) for perishable food products with a pilot for the tomato shipment already underway. There is

2.4.4 Market

a) **Traffic constraints and rough offloading at major markets**: In major vegetable markets such as Mile 12 (40-year-old market located along Ikorodu road, Lagos), significant amounts of tomato, onions and chili are lost due to rough offloading and traffic constraints in and around the market. Despite its fame as the premier market for all fresh food items in Lagos, Mile 12 is also known for its waste disposal challenges, environmental and traffic constraints. According to reports, on the Mile 12 market corridor, an estimated 50,000 vehicles are caught in the traffic every morning and evening, costing motorists a total of about USD 24 million per year in only fuel costs.[50] There are usually long queues of trucks waiting to offload products at the market, leading to significant delays and in turn food spoilage even before they are offloaded. According to a report by The Guardian (2016) Visitors to Mile 12 market "know two things are just as important as money: a pair of rubber boots to protect

their feet and shoes from getting soiled, and a handkerchief to reduce the assault of human and material waste on their nostrils […] Passersby could barely walk past without holding their breath, due to the stench of decaying onions". [51] The UK (DfiD) appears to show interest in supporting the Lagos State Government in building an ultra-modern market at Mile 12. This could be an opportunity for RVO to be involved in (Lagos alone has around 33 markets, most of them with similar situation and in need of re-building).

b) **Importation of tomato pastes and concentrates**: Annually, Nigeria imports around 150,000 mt of tomato paste. The Tomato Policy reform announced in 2017, included the import substitution of tomato paste and concentrates, so as to stimulate investments in Nigeria's tomato processing industry, create jobs, and contribute to reducing post-harvest losses (particularly during the glut period when there is an oversupply of tomatoes). The policy placed an increase in tariffs on tomato triple concentrate from 5 to 50%, with an additional levy of USD 1,500 per metric ton, to dissuade importation. Nevertheless, importation of tomato paste is still thriving as foreign tomato products are still increasing on retail shelves. Sector experts maintain that this is due to two reasons, foreign tomato paste is smuggled in from Cameroon and Benin Republic; and tomato supply and processing is still not optimal in Nigeria. The Nigerian Minister of Agriculture expressed the government's intention to place a ban on importation of tomato paste by 2021. Also, the Managing Director of Dangote Tomato Processing plant has called on the government to place a ban on the importation of tomato paste, so as to enable the private sector to invest in employment and reduce post-harvest losses through processing.[52]

Chapter 3. Actors, Structure and Governance of the Value Chain

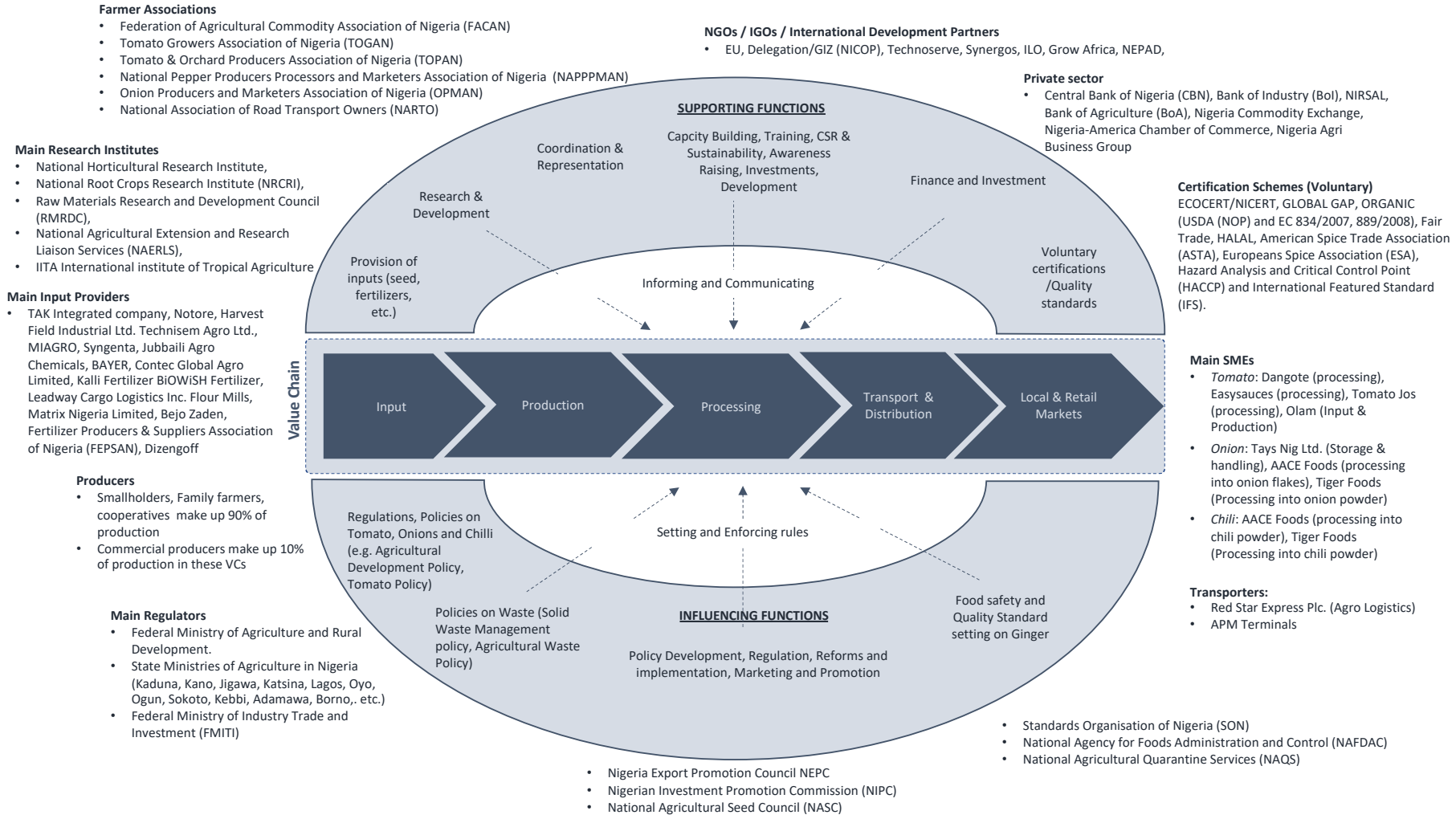
This chapter describes the chain structure, key stakeholders, and governance of the three value chains. Where it is observed, the governance dynamics are also noted.

3.1 Chain Structure and Governance for Tomato, Onion and Chilli VCs

The figure below is a diagrammatic illustration of the key actors, structure and governance of the value chains. The structure of each value chain is already presented in Chapter 2.

Figure 13: Summary of Key actors and governance in tomato, onion and chili VCs

(Source: mapping developed by authors based on input from study participants and literature)



3.2 Chain Actors

The production of tomatoes, onions and Chilli takes place on small farms of less than 1 hectare to farms of several hectares.[53] According to PWC (2017) there are around 200,000 tomato producers in Nigeria. The size of chili and onion farmers in Nigeria are unknown. Hundreds of families depend on these three VCs for their livelihood.

The main challenges faced by producers, are poor access to high quality seeds and input, lack of know-how to implement GAP practices, as well as inadequate support from government extension workers. Production yields for all three VCs are low compared to other countries and at least tomato and onions have experienced severe production setbacks due to diseases. For tomato, in 2016, the disease *tutal absoluta* caused significant crop losses, while for onions, in 2019, a fungal infection – *purple blotch* (in hausa language: *dan zazzalau*)[54] - attacked onion crops during the rainy season resulting in huge losses for the farmers. The VCs are increasingly ageing, and the literacy level of farmers and traders is low, as majority of producers and traders (mostly women) are above 50 years of age, with low educational levels.

Farmers and traders have "*captive"* governance relationship.[55] This is more pronounced in the onion value chain. For instance, the traders are not only buyers of onions; they also "supply" seeds and fertilizers to farmers. As most farmers are poor and often lack funds to purchase seeds and fertilizers, the farmers negotiate to trade in their crops for these inputs. As a result, these farmers become financially dependent on the traders. Farmers are also unaware of the price dynamics of their products and as such most traders take advantage of this.

it was noted that tomato farmers purchase bulk seed and fertilizer from Agro-dealers without knowledge of the seed characteristics (e.g., maturity period, shelf-life traits etc.), or appropriate application rates for fertilizer resulting in poor production which influences profitability and leads to wastages. For Chili farmers a core challenge observed is that almost 75 percent of them do not participate in any chili pepper-related cooperative or association, because they are unaware of the existing associations and the benefits that membership holds. A study conducted shows that 98.5 percent of chili farmers 98.5% of chili farmers finance their production from own savings, while only 1.5 obtained credit through Bank of Agriculture. The low access to credit is attributed to the fact that government seldom grants financial credit to Chili farmers.[56]

SMEs involvement

There is high SME involvement in the three value chains, from input suppliers to commercial SME farms, to SME processing factories, traders, transport companies and retailers (some of which are highlighted in figure 13. Most of these companies have employee sizes ranging from 10 to 50 and estimated revenue of < 500,000 euros per year. Only a handful of the highlighted companies were set up cognizant of the need to address food loss. For example: Dangote (Tomato) and Tays Foods (Onions) and Easy Sauces Nigeria Ltd. (Tomato, Chilli, Onions). A few important companies focusing on these three value chains are highlighted below:

1) Dangote Tomato Processing Factory: recently established a 6.5 million Euros greenhouse nursery in Kano, the facility is designed to process between 300 and 350 million tons of hybrid tomato seedling, towards making Nigeria self-sufficient in tomato production. According to Dangote, the Green House Nursery will facilitate increased production of high-quality seedlings. Nigeria currently consumes about 2.3 million tons of tomato paste, the Dangote farm plans to produce to a capacity of 8 million annually, which exceeds local consumption. In the past, the company faced setbacks due to significant production losses from *tuta absoluta*.
2) Tays Foods Limited: is a Nigeria based company, that specializes in onion handling and storage. The company states that its main objective is to reduce wastage of onions by providing modern onion storage facilities, which will in turn increase the income of the farmers and prevent market price fluctuations. They explicitly note that the provision of modern onion storage facilities will help to prevent wastage, stabilize the onion prices, ensure that there is availability of onions all year round, boost onion farming, make for bigger harvests and boast the Nigeria economy.
3) GBfoods Africa: GBfoods is a multinational EU culinary product manufacturing company based in Barcelona, with a turnover of around €1,2 billion and a staff of around 3,000 employees, GBfoods is present in more than 50 countries in Europe and Africa.[57] GBfoods Africa is the company's subsidiary in Nigeria with recognizable brands such as Gino (tomato sauce), Bama and Jago mayonnaise. During the

summer of 2020, GBfoods in partnership with the Central Bank of Nigeria (CBN), Kebbi State Government and the Emirate of Yauri established a 20 billion Naira (43 Million Euros) Tomato processing factory in Kebbi state, expected to be the largest fresh tomatoes processing factory in Sub-Saharan Africa. The tomato factory will convert fresh tomatoes into tomato concentrate used for producing Gino Tomatoes Paste and Gino Tomato Pepper Onion Paste. It is expected that the project will create over 1,000 jobs (including 500 farming jobs, 150 factory jobs and 150 construction jobs) and engage over 5,000 smallholder farmers as out-growers.[58]

4) Easy Sauces Limited: is an SME that processes fresh tomatoes, chili and onions into sauces for stews, soups, pasta and local Nigerian dishes which require sauces. The company explicitly notes that it envisions contributing to addressing the challenges of food insecurity and food loss in Nigeria through processing and preservation of tomato, chili and onions. It works with about 150 farmers and employs about 48 staff and 550 (annually)/seasonal factory workers. Its estimated revenue for 2019 was around 500,000 Euros.

5) Tomato Jos: Established in 2008, the company processes tomato into paste. Its founders set it up after discovering that although Nigerian farmers produced 65 percent of the tomatoes grown in West Africa, paradoxically, it was also the largest importer of tomato paste in the world. The company explicitly links tackling the challenges of post-harvest losses in the tomato value chain to its business. Besides processing, they also provide "Dami" services (*Dami*=Bundle) include providing farmers with agro-inputs, education and transportation of their tomatoes to market. Tomato Jos has 20 employees. The company currently directly supports over 70 smallholder farmers across three growing cycles. Their growth plans include the installation of a drip irrigation system and a processing plant that can produce 24 tons of finished product per day. At scale, Tomato Jos will work with thousands of smallholder farmers on over 2,600 hectares of land, putting more than 1 million USD of direct income into the local economy each year. Recently, Tomato Jos raised 3.9million Euros in a funding round that was led by Goodwell Investments, (via Alitheia Capital) and Acumen Capital Partners and VestedWorld.

6) Olam Nigeria Limited: Through its subsidiary, Caraway Africa Nigeria Limited, produce about 30 metric tonnes of fresh tomatoes per hectare in each farming cycle from farms in Karfi in Kano State, Masama and Guri in Jigawa State. The company started production in October 2019. Olam recently has partnered with World Vegetable Centre, a renowned research institute, seed producer and developer, to help supply 18 varieties of tomato seeds in the firm's newly acquired 20 hectares farmlands in Kano and Jigawa states in order to ramp up the country's annual production capacity. Olam intends to establish partnership with developmental organisations to draft 1,000 tomato farmers across the country, in its out grower programme as it plans to acquire 500 hectares of farmland solely for tomato production, and processing of tomato will commence in February 2021.

7) Dizengoff: Dizengoff Nigeria Limited is a subsidiary of Balton CP Group.[59] It has been operating in Nigeria for 60 years and has two business divisions, Agriculture and Communications Technology. Under its agricultural division, Dizengoff provides mechanized farming solutions, irrigation solutions, greenhouse technology, seeds, fertilizers and agro-chemicals, as well as training and agro-support to horticulture farmers.

Only a handful of companies such as Dangote Tomato processing factory, Olam Nigeria Ltd., GBfoods, Dizengoff have significantly higher revenues and employee size, mostly because they are part of a larger company Group. The bigger companies have competitive advantage given the fact that they are able to easily raise capital to acquire large farmlands for cultivation, enlarge their processing factory capacity and procure the required equipment and machinery. Nevertheless, the fact that Tomato Jos (a smaller company) is able to raise almost 4 million Euros in capital,[60] shows that SMEs in these VCs with innovative ideas and plans could be also competitive. It is worth noting that Tomato Jos started with about 500,000 USD through local and foreign Angel Investors.

Transport and Logistics

The transportation part of the value chains of tomato, onions and chili contributes significantly to losses. Poor conditions of trucks used in transportation, poor road conditions and insufficient cold chain solutions by transporters have been raised as the main causes. In addition, it is quite expensive to transport products from the North to South of Nigeria, in fact, sector stakeholders indicate that it costs more to move goods within Nigeria than from abroad. Transporters claim that the high costs are due to unnecessary roadblocks and delays

by security personal on highways and the high amounts of multiple taxes they are forced to pay before reaching their final destination.[61]

- APM Terminals: Together with Naija Pride APM Terminal is working to provide modern cold chain transportation alternatives for farmers in the agricultural centers of northern Nigeria to bring fresh produce intact and unspoiled to market centers in Lagos. Recently, the first pilot shipment of 18.6 metric tons of fresh tomatoes, was transported from Kaduna to Lagos.
- Red Star: Red Star Express Plc. is Nigeria's leading logistics provider. It is a listed company (Nigeria Stock Exchange) with over 150 offices in Nigeria that services 1500 communities.[62] Red Star has 4 subsidiaries one of which offer Agro Logistics specialized services for movement of agricultural produce. They claim to offer cold chain solutions to keep products fresh along the chain till delivered to final consumer and offer full truckload services as well as less than truck load services for agricultural goods.[63]

Markets:
About 1 percent of tomato are sold in formal markets as paste or puree, while the rest are sold fresh in informal markets. Formal markets include supermarkets, restaurants and hotel chains such as Shoprite, UAC, Unilever, Eko Hotels, Best Choice, SPAR, Artee (and its subsidiary Evergreen), Massmart, Jumia, etc. There are several informal markets in the Southern part of Nigeria where the majority of tomato, onions and chili are sold. The most popular one in Lagos is Mile 12. According to a study conducted by WUR (2019), the vegetable value chains in Nigeria are highly organized but are informal when it comes to making agreements and arrangements between value chain actors. About 95 percent of food is in informal markets of which the main ones are based in the Southern parts of Nigeria. Mile 12 is the leading wholesale markets of the more than 30 of such informal markets. Others are Ibadan having the Sasha and Bodija wholesale markets and in Plateau State the Bokkos market is leading for the national trade in potatoes. Wholesale traders maintain a dominant position in linking producers to consumers (e.g., the trader association in Mile 12 in Lagos is very organized and influential).[64]

3.3 Chain Supporters

3.3.1 Associations

Several associations exist at national and local level that support tomato, onion and chili farmers in organizing, advocating/lobbying and capacity development[65].

- A few of them are recognized at national level, e.g., Tomato Growers Association of Nigeria (TOGAN), Tomato and Orchard Producers Association of Nigeria (TOPAN)[66] – around 115,666 members[67] and the National Tomato Growers, Processors and Marketers Association of Nigeria (NTGOMAN),[68] Onion Producers and Marketers Association of Nigeria (OPMAN), and the National Pepper Producers, Processors and Marketers Association of Nigeria. Sector associations are members of the Federation of Agricultural Commodity Association (FACAN).
- *FACAN*: an active umbrella association at Federal level with over 50-member commodity associations. Recognized by the Nigerian government as the apex commodity association, FACAN was initiated in 1991 as an alternative to the then defunct marketing boards. The association became active in 2010 and now assumes the mission of "promoting mutual understanding among the agricultural commodity associations and creating an enabling environment for a unified agricultural sector that is better positioned operationally and financially to deliver to itself and the general public, value added services in agriculture and allied business".
- Mile 12 Traders association and National Association of Road Transport Owners (NARTO) are two very influential associations representing traders (at Mile 12) and transporters respectively. Mile 12 is the leading wholesale vegetable market in Nigeria. NARTO is said to be the biggest employer of labour next to the Federal Government. The association comprises all commercial vehicles owners in Nigeria engaged in haulage of products, general cargoes, and passengers, within the country and the entire West-Africa sub region.

3.3.2 Research Institutes

- The Raw Material Research & Development Council (RMRDC) based in Abuja, is a government agency tasked with promoting the development and utilization of Nigeria's industrial raw materials (including agro raw materials).[69] In recent years, the RMRDC has distributed improved tomato seeds to vegetable farmers in several states.[70] Also, RMRDC has been working on partnering with entrepreneurs and researchers to improve the production, processing and marketing of chili pepper and other spices in Nigeria.[71]
- The National Horticultural Research Institute (NIHORT) based in Ibadan, works to promote and implement research and development on new hybrid tomato seeds for all ecological zones.[72]
- National Root Crops Research Institute (NRCRI), based in Umudike, NRCRI has a mandate to provide research and improve knowledge on tuber and root crops in Nigeria.[73]
- National Agricultural Extension and Research Liaison Services (NAERLS): NAERLS is responsible for the development, collation, evaluation and dissemination of proven agricultural innovations and to provide research on agricultural extension methodologies and policy. NAERLS has more than 700 employees, including over 90 Extension Specialists.[74]
- International institute of Tropical Agriculture (IITA): IITA aims to create agricultural innovations by providing research around staple food crops.[75]
- Nigerian Stored Products Research Institute (NSPRI): NSPRI aims to reduce post-harvest food losses by researching waste reduction storage methodologies for different types of crops (cereals, legumes, roots, tubers, fruits, vegetables, meat, fish, etc.).[76]

3.3.3 NGOs and IGOs

Some NGOs and IGOs have projects in the three VCs, examples are in section 5.2.

3.4 Chain Influencers

3.4.1 Federal and State Ministries

The principal chain influencers in the tomato, chili and onion value chains are the Federal and State Ministries of Agriculture. For tomato and chili, the State Ministries of Agriculture of Kano, Kaduna, Jigawa and Katsina (the so-called Tomato Triangle) are important stakeholders. For Onions, one of the main regulators is the State Ministry of Sokoto state.

- Federal Ministry of Agriculture and Rural Development (FMARD): FMARD is the national government body that organizes and manages the agricultural sector including policy and legislation development. FMARD facilitates and promotes agriculture while ensuring food security, promoting production, marketing, foreign exchange and development.[77]

3.4.2 Regulatory Agencies

- Nigerian Export Promotion Council (NEPC): NEPC is mandated with the promotion, development and diversification of all non-oil products exports. Aims to diversify the Nigerian exports away from oil-products, organizes and coordinates national programs, promotion activities and capacity building.[78]
- National Agency for Food and Drug Administration and Control (NAFDAC): NAFDAC regulates and controls "the manufacture, importation, exportation, advertisement, distribution, sale and use of food, drugs, cosmetics, medical devices, chemicals and packaged water in Nigeria".[79]
- Nigerian Investment Promotion Commission (NIPC), is charged with encouraging, promoting and coordinating investments in Nigeria. It provides investors with key information regarding opportunities, incentives and access to finance for the Agriculture, Industry and Services sectors.[80]
- National Agricultural Seed Council (NASC) is charged with the overall development and regulation of the national seed industry. According to the NASC, "there are 157 registered seed companies in Nigeria, with the majority producing fewer than 1,000 tonnes of seeds annually. The Seed Entrepreneurs Association of Nigeria is the country's main private seed trading body, with approximately 67 registered members".[81]

Regulatory Agencies responsible for waste management in Nigeria

Nigeria has different ministries, agencies and departments engaged directly or indirectly with waste issues. These include the Federal Ministry of Environment, State Environmental Protection Agency, State Ministry of

Environment, different Local Government and Area Councils and the National Environmental Standards and Regulations Enforcement Agency (NESREA). Of the lot, NESREA (set up in 2007) an agency of the Federal Ministry of Environment is the central organisation mandated with the development of new, and review of existing national environmental laws and regulations (including on wastage).[82]

3.5 STEEP trend analysis

3.5.1 Social

On the long term, Nigeria's population will continue to increase, and this will lead to an increase in the level of consumption or demand of tomato, onion and chili in local delicacies. While this is positive in that there is a good local demand/ market for tomato, chili and onions, production needs to meet the demand gap otherwise, Nigeria will continue to spend resources on importation. Sector experts believe that this trend will be reversed positively due to government's renewed interest and investment in agriculture and in particular these value chains. The endemic culture of indiscriminate waste generation and disposal by citizens in Nigeria will not abate in the coming years, unless there is significant awareness raising and economic sanctions for poor waste handling practice. Although the commercial side of these value chains will continue to be dominated by men *(According to Global Gender Gap Index 2020 report, only 13 percent of Nigerian firms have female majority ownership, and similar percentage with firms with female top manager*),[83] it is expected by sector experts that over the next 2-3 years, there will most likely be more processing factories/SMEs that are women owned or led. Already there some examples of this trend, such as Tays Foods Limited (onions) and Tomato Jos (tomato) which are successful SMEs led or owned by women. Both companies have identified food loss at the center of their corporate mission.

3.5.2 Technological

The increasing use of technological initiatives in agriculture such as Blockchain, Artificial Intelligence, Drones, has a potential of enticing more Nigerian youths to invest in and take up responsibility in agriculture in the coming years. Companies like BeatDrone based in Lagos who are supporting farmers with soil analysis and improvement using drones show how youth could be engaged in agriculture.[84] Another area is app development by youths for tackling key challenges in the agricultural sector. An example is the app "Chowberry" developed to address the issue of food waste by consumers.[85] Apps for smart agriculture, and digital tools for traceability of agricultural supplies and in transport and logistic. Appalled at the very low yields of crops as well as very high post-harvest losses in Sub-Saharan Africa, some Nigerian youths created "Kitovu" an agricultural-focused technology company that uses data to eliminate agricultural supply chain inefficiencies.[86] Cellulant developed "Agrikore" a blockchain based smart-contracting, payment, and marketplace system which is designed to ensure that stakeholders in agricultural value chains can do business transparently.[87] Farmcrowdy: is a digital agricultural platform that "empowers rural farmers by providing them with improved seeds, farm inputs, training on modern farming techniques and provides a market for the sale of their farm produce".[88]

Production and packaging are still largely done manually using mostly hand tools in these value chains. Over the next couple of years, as government and private sector initiatives open up possibilities for access to finance (e.g., Anchor Borrowers Programme), more producers and processors will increasingly invest in modern equipment and tools. This will likely lead to increases in the use of mechanization/tractorization and automation in these value chains. The likes of "Hello Tractor", an app that links the farming community to tractor hiring services is crucial to this trend.[89]

In addition, according to FARA (2016), broadband penetration is low in Nigeria. Projects such as the Trans-Sahara Backbone Optical Fibre project (a 10-year project partly financed by the Africa Development Bank and the EU), aims to provide better broadband connectivity, with new optical fibre connections that could prepare the way for improved e-government initiatives (i.e., standard platforms, government internet portals and online services, etc.). The project will also develop a "Market and Climate Information System" aimed at enabling farmers to access information on agricultural commodity prices, real-time data on weather forecasts, credible data on rainfall and water-level forecasts, so that they are able to better adapt to climate change effects, reduce post-harvest losses and extend their markets.[90]

3.5.3 Ecological

Climate change exacerbates irregular rainfall patterns, increase in pests and diseases, declining soil fertility and rapid depletion of resources (land, water and energy). Regarding food loss in Nigeria, climate change will

definitely continue to be a major factor in the coming years. Studies indicate that globally food loss (and waste) is responsible for an "estimated 8 percent of annual greenhouse gas emissions, consumes a quarter of all water used by agriculture each year, and requires agricultural area the size of China, to grow food that ultimately is not eaten by people".[91] Reducing losses in food value chains would contribute to lowering these environmental impacts.

Nigeria is the 55th most vulnerable country to climate change and 22nd least ready. Overall, climate change is projected to cost 6 – 30 percent of Nigeria's GDP by 2050, translating to USD 100 billion – USD 460 billion in losses.[92] Nigeria has a climate policy in which it states that through the implementation of climate smart agriculture, it aims to potentially reduce 74 million tonnes of GHG emissions per year by 2030.[93] Nigeria also has a National Policy on the Environment, a Solid Waste Management Policy and an Agricultural Waste policy in draft (see section 3.5.5 , all of which creates potential for addressing food loss. Nevertheless, Nigeria lacks a central policy and coordinated strategy to address food loss from agricultural supply chains.

Most likely the concept and knowledge of circular economy and its application in combating food and agricultural losses and wastes, will increase in Nigeria, see section 5.3.1 "*possibility of applying circular economy solutions"*. According to the UNFCCC, there is vast scope to tackle food loss and waste and reduce GHG emissions by applying circular principles. The Netherlands has set a target of becoming 50 percent circular by 2030 and fully circular by 2050,[94] therefore as a frontrunner on CE approach, RVO could leverage this to explore the possibility of stimulating CE approach to address food losses in Nigerian food value chains (with accent on the selected three VCs – tomato, onions and Chilli).

3.5.4 Economic

On the long term, the impact of border closings and ban on imports of tomato paste and concentrate is expected to spur local economic activity in these value chains. Currently food losses lead to huge economic losses for the country, and the lack of sufficient production to meet the domestic demand is likely to lead to limited export and more import. Presently, onions in Nigeria are scarce and the price is significantly increased, as a bag of onions is 200 percent more expensive.[95]This will create economic hardships for farmers and consumers.

3.5.5 Political

As noted in section 5.1, the Nigerian government (through various agencies) is implementing several agricultural initiatives that apply to the three value chains, some of which focus on addressing food loss and/or waste. Nevertheless, we highlight four critical political economy (policy and structural) issues that still require attention, which uniquely exacerbate food losses in the three value chains.

A. **Lack of a central policy and coordinated strategy to address food loss from agricultural supply chains**.

It is a widely held view that national governance on wastes in Nigeria is weak despite the myriad of key legislative frameworks on waste existing in the country (see table below). Nigeria has a national policy on the environment which highlights the need to address different waste streams but fails to mention or address significant wastages from agricultural post-harvest losses.[96] The country also has an agricultural policy which barely addresses wastages from agricultural post-harvest losses. It however mentions an intention to focus on agricultural commodity processing, "to preserve perishable agricultural commodities thereby reducing their level of waste and the degree of their seasonal price fluctuations".[97] Only recently (in July 2020) has Nigeria approved a new national Solid waste management Policy.[98] Sector experts inform that the policy will provide a framework for the integration of efforts by the federal, state and local governments, ministries, departments and agencies, non-governmental organisations (NGOs) and other stakeholders on waste management. The new policy document takes into account the wastes generated from agricultural production but lacks depth in proposing how to address these wastes.

Key Legislative Framework for Waste Management.
(Source: Trinomics, et al 2019)

Relevant Policies / Programmes	Description
Harmful Waste Act (1988, 2004)	Prohibits and declares unlawful all activities relating to the purchase, sale, import, transport, deposit or storage of harmful waste
FEPA Act (1988)	Establishment of the Federal Environmental Protection Agency
EIA Act (1992)	Legislation in the field of Environmental Impact Assessments

Relevant Policies / Programmes	Description
Environmental Pollution Control Law (1996)	Requires the ministry of Environment and Physical Planning to educate the public on the types of disposal methods acceptable by the State Government for domestic and industrial wastes
Constitution of the Federal Republic of Nigeria (1999)	(Section 20) states the federal government is empowered to protect and improve the environment and safeguard water, air, and land, forest and wildlife.
Policy guidelines on Solid Waste Management (2005)	This document provides a good overview of how solid waste management should be organized in Nigeria, which organisation is responsible for what, etc.
NESREA Act (2007)	Establishment of the National Environmental Standards and Regulations Enforcement Agency
National Environmental Regulations (2009)	Legal framework for the adoption of sustainable practices in environmental sanitation and waste management to minimize pollution
National Environmental (WEEE) Regulations (2011)	Imports of near end of life and waste electric and electronic equipment are banned
National Policy on the Environment (1991, 1999, 2016)	The goal of the National Policy on the Environment is to 'ensure environmental protection and the conservation of natural resources for sustainable development'. The strategic objective of the National Policy on the Environment is to coordinate environmental protection and natural resources conservation for sustainable development. This goal will be achieved by the following strategic objectives: • securing a quality of environment adequate for good health and well being; • promoting sustainable use of natural resources and the restoration and maintenance of the biological diversity of ecosystems; • promoting an understanding of the essential linkages between the environment, social and economic development issues; • encouraging individual and community participation in environmental improvement initiatives; • raising public awareness and engendering a national culture of environmental preservation; and • building partnership among all stakeholders, including government at all levels, international institutions and governments, non-governmental agencies and communities on environmental matters. [99]
Solid Waste Management Policy (2020)	• Promoting a clean and healthy environment for sustainable socio economic • development of the nation. • Reducing and eventually eliminating illegally dumped solid waste and • reduction in associated public health problems. • Development of waste management infra structures. • Promoting private sector investments in Solid Waste Management. • Promoting the Reuse, Reduce, Recycle and Recovery initiative. • Restoring and Conserving natural resources. • Creating wealth and employment from waste management.
National Plastic Waste Policy (2020)	The overall goal of the National Policy on Plastic Waste Management is to promote sustainable use of plastic as a resource through its life cycle management. The focus is heavily on single use plastics. • Develop legislative instruments, standards, trade measures, models and systems • Limit the impact of littering of certain single use plastic packaging products and waste materials in the Nigerian environment. • Reduce Plastic Waste Generation by 50% of its baseline figure of 2020 by year 2025. • To effect levy and sector user charges on single use plastic under the • Extended Producer Responsibility effectively from May 2021 • To transform all plastic products, packaging materials and its waste to a resource • To ensure that all plastic packaging in the market meet at least two criteria • of being recyclable or biodegradable or compostable or reusable by 2030 • To promote the sustainable use of alternatives to single use plastics e.g. • Jute bags, leaves, paper glass bottles, from May 2020. • To generate a database on plastic from production through use to its disposal including import or export taking cognizance of lifecycle approach in the country for informed decisions on partnerships with relevant stakeholders (retailers,

Relevant Policies / Programmes	Description
	manufacturers, recyclers, NGOs, governments and local authorities) around a specific goal.

Furthermore, it is noted that a separate Agricultural Waste Management policy is still in draft since 2012 (i.e., Federal Republic of Nigeria, National Policy on Municipal and Agricultural Waste (MAW) Management, Aug. 2012), which was developed together with UNEP. It is unclear if this policy is robust enough to address the reduction of wastages from agricultural post-harvest losses. The policy is yet to be adopted or developed into a comprehensive legislation and plan to address agricultural wastages in Nigeria and the reasons for this is largely unknown.

Overall, Nigeria lacks a central policy and coordinated strategy to address food loss from agricultural supply chains. RVO could engage with NESREA to develop this. The Agricultural Waste Management Policy which is currently in draft provides an opportunity to elaborate on a policy and strategy for dealing with food loss in agri-food chains.

B. **Endemic corruption and bureaucracy in the country exacerbates disruptions of the supply chains for these three value chains and lead to significant losses**. In section, 2.4, a clear illustrative case of corruption highlighted was of bribery and extortions by government security personnel on major highways and trade corridors for the three value chains (i.e., Kano to Lagos) - Government forces create several roadblocks and request documentation and un-official fees as rite of passage for transporters. This leads to disruption in the chain, unnecessary delays, high costs, and decline in condition of perishable products with short shelf-life.

Roadblocks and extortions by government security agents not only exist on major highways, but also on local road networks leading to local markets. For instance, there is press account that "women selling tomatoes, peppers in the markets are forced to increase prices to remain in business, alleging that they pay revenue to government and also settle security agents to allow them carry the goods to the market". [100]

According to the 2017 corruption survey of the Nigerian National Bureau of Statistics (NBS), about 169,000 euros (or 82 million Naira) was paid in bribes to government officials in 2017, and more than a third of Nigerian adults that were in contact with public officials had been asked to pay a bribe. The survey indicates that truck drivers transporting goods and taxis were the worst hit as they are "less likely to challenge authority and are often pressed for time, so they would rather pay a bribe". [101]

In 2017, the Nigerian Inspector General of Police ordered the "dismantling of all roadblocks nationwide with immediate effect; particularly on the following routes, Lagos-Ibadan, Shagamu-Benin, Benin-Onitsha, Okene-Abuja, Kaduna-Kano, Katsina – Kano, Otukpo – Enugu, Enugu – Port Harcourt Express Ways. The directives became necessary to enable ease of doing business in Nigeria, safeguard, and guarantee free passage of goods and travelers throughout the country".[102]

Nevertheless, this is not the first time such an order was issued by the policy force. Enforcement of such orders has always been the challenge; the directive is adhered to for a short period of time and then the roadblocks return.[103] In fact, as of July 2020, there were press reports that "the numerous checkpoints and roadblocks on the highways and roads across the country by security agencies, including the Police, Customs, Military and Federal Road Safety Commission (FRSC), have been identified as one of the reasons for loss of man hours, increased prices of consumer goods and services and other items, especially since the outbreak of COVID-19 pandemic".[104]

The Nigerian Taxes and Levies Act, Laws of Federation of Nigeria 2004 section 2 (2) prohibits, "any person, including a Tax Authority from mounting a Roadblock in any part of the Federation for the purposes of collecting any Tax or Levy".[105] International development and trade interventions need to focus on supporting these government security agencies to effectively enforce this Act and their roadblocks policy to prohibit illegal or unlawful blockage and obstructions on Highways and Roads, created by unlawful Revenue/Tax collectors, Road Transport Unions, Labour and Trade-related unions.

C. **Security situation in parts of Northern Nigeria and in highway/trade routes of these three value chains create disruption in supply of these three value chains and lead to significant losses.** Insecurity and conflicts over land use is a serious risk and threat in agriculture and business investments in the sector. Many violent outbreaks have occurred due to such conflicts, for instance between Muslim Fulani herdsmen and Christian farmers in Nigeria's Northern and Middle Belt States. Despite efforts by the Nigerian Government, Boko Haram (and the Islamic State in West Africa, ISWA) continues to be a threat to agricultural communities and their livelihoods in the Northern part of Nigeria, from where most of the tomato, onions and chili originate.[106]

Furthermore, most Nigerian roads and highways (particularly transit routes for the three VCs) still report significant levels of insecurity with armed criminals robbing and at times kidnapping road users. This security risk is exacerbated by poor road conditions, lack of grid power on major roads and highways, limited road safety instructions, weak protection from public security agents, and endemic corruption in the Nigerian public security system (e.g., extensive roadblocks by public security personnel).[107]

As mentioned in section 2.4.1, tomato, onion and chili producers stress that security incidents and recent outbreaks of violence especially in the Northern part of Nigeria, cause disruptions and ultimately lead to on farm and post-harvest losses in the three value chains. In particular, cases highlighted include herdsmen encroaching tomato and onion fields,[108] and insecurity and armed robbery during highway transit and supply corridors.[109] When these incidents occur, products in the fields are often abandoned, and sometimes, packed produce in trucks are damaged or destroyed, leading to significant losses.

Several expert reports indicate that there is need for security reforms in Nigeria; in particular, a recent Chatham House (2019) article, elaborates on the weaknesses of the current security set up in Nigeria and proposes three main reforms:

1. To address the endemic corruption and abuses of power in Nigeria's public security system and create greater transparency and better oversight, the government should create "Inspector General Offices tasked with exposing corruption and abuses" in the force.[110] The Inspector General will act as a watchdog who is part of the government, but at the same time independent from the entity they are tasked with investigating. They would conduct independent audits and investigations and report their findings and recommendations to Congress and the office of the Presidency.
2. To "create operational centers of gravity, yield budgetary efficiencies, reduce bureaucratic overheads and break down intelligence silos, Nigeria needs to consolidate its numerous security agencies". [111]
3. "Nigeria's international partners should advocate for sensible security sector reforms, and condition or structure their security assistance in such a way that enables and incentivizes specific reforms". [112] This particular recommendation is apt for the Netherlands – Nigeria relationship, given that recently (2019), the Netherlands pledged to provide humanitarian assistance to those in need (especially girls and women) to mitigate the impact of insecurity and displacement caused by the security situation in the Northern part of Nigeria.[113] Such a relationship could be leveraged to encourage sensible reforms in Nigeria's public security sector.

D. **Sub-optimal implementation of the Tomato Policy and lack of strategic policies for Onion and Chili value chains**.

The Tomato Policy reform was announced in 2017 by the Nigerian government. Sector experts noted that the aim of the policy reform is "to stimulate investments in Nigeria's tomato processing industry, create jobs, and contribute to reducing post-harvest losses (particularly during the glut period when there is an oversupply of tomatoes)". The main measures of the tomato sector policy comprise the following, amongst others:[114]

- The classification of greenhouse equipment as agricultural equipment in order to eliminate import duty
- Cessation of the import of tomato paste, powder and concentrate for retail sale, and of tomatoes preserved in vinegar or acetic acid
- An increase in the tariff on tomato triple concentrate from 5 to 50%, with an additional levy of USD 1,500 per metric ton
- Restriction of the import of tomato concentrate to seaports, with the aim of addressing the current abuse of the ECOWAS Trade Liberalization Scheme (ETLS);
- Introduction of a zero-rate tariff (for both customs and excise duty and VAT) on the import of equipment for the production of tomato concentrate
- A 3-year tax holiday for investors in tomato-processing plants using fresh fruit to produce paste in Nigeria

- Removal of the current monopoly on agricultural insurance enjoyed by the Nigeria Agricultural Insurance Corporation (NAIC) to allow private sector players into the market
- Development of good agricultural practices (GAPs) to be followed in Nigeria in order to guide both increase yields and bring production into line with international standards
- The institutional provision of credit support to all tomato farmers
- Establishment of an inter-professional forum comprising input dealers, Government agencies, processors and packers, farmers' associations, banks and donor agencies for regular dialogue on the entire tomato chain
- The inclusion of tomato production and processing in the list of industries eligible for investment incentives administered by the Nigeria Investment Promotion Commission (NIPC)

As of now, some of the crucial aspects of the policy reform are still not optimally implemented. For instance, there is still no HS custom code for greenhouses and as a result, the import duties on greenhouses are still not eliminated. Also, the policy placed an increase in tariffs on tomato triple concentrate from 5 to 50%, with an additional levy of USD 1,500 per metric ton, to dissuade importation. Nevertheless, importation of tomato paste is still thriving as foreign tomato products are still increasing on retail shelves. Sector experts maintain that this is due to two reasons, foreign tomato paste is smuggled in from Cameroon and Benin Republic; and tomato supply and processing is still not optimal in Nigeria.

There is pressure on the government to optimally implement the tomato sector reform policy. The Nigerian Minister of Agriculture expressed the government's intention to place a ban on importation of tomato paste by 2021. Also, the Managing Director of Dangote Tomato Processing plant has called on the government to place a ban on the importation of tomato paste, so as to enable the private sector to invest in employment and reduce post-harvest losses through processing.[115] It is also noted that there are no major sector policy reforms for Onion and Chili. RVO, the Netherlands Embassy in Abuja and the Netherlands Consulate General in Lagos could through diplomatic channels support the Federal Ministry of Agriculture and Rural Development, FMARD) on full implementation of the Tomato sector policy and to develop policy reforms for other value chains such as Onions and Chili.

E. Sector organisations and associations (at each part of the value chain) lack coordination and leadership on the issue of agricultural food loss.

As noted earlier, tomato, onion and chili value chains have active associations at representing farmers, processors, transporters and marketers. Several of these associations have clear governance structures including management roles and responsibilities, they are often recognized or inaugurated by the Nigerian government.[116] Some are also active in influencing the government's agricultural and sector policy initiatives. However, according interviewees, one of the main sector constraints is that associations still have a lot to learn when it comes to providing effective coordination with other chain actors, marketing and service delivery for their members.

Interviewees specifically mentioned that associations lack knowledge and skills to provide effective training and coaching on dealing with on-farm and post-harvest losses, literacy skills on proper financial management, skills for defining a strong business model, crop planning as well as marketing, particularly in anticipation of seasonal glut, and lack of strong skill set to market their value chains to off-takers. Furthermore, a survey (2018) conducted among hundreds of tomato farmers, hauliers and traders, by Agrofair et al in Kano, revealed the following when asked their opinion on the value of sector associations:

- "Foreign intervention programmes (World Bank, NGOs) provide limited say in the organisation,
- Most leaders of associations are fighting for themselves, and not for the farmers
- In some regions it works when people are better informed, and
- In Kano, association brings benefits (or practice it) but the results are disappointing".[117]

Some interviewees also stressed the lack of transparency and visibility of the work of many agricultural associations, particularly tomato, onion and chili associations. Several of these associations do not have functional websites and the ones that have websites, lack up-to-date information. In addition, there is generally a proliferation of associations which makes it challenging to know which associations are trustworthy and can genuinely and effectively represent value chain actors. Two main legislative frameworks govern the registration and establishment of associations in Nigeria (i.e., The Cooperative Societies Act of 2004,[118] and the Cooperative Development Policy of Nigeria of 2002).[119] A recent (2019) legal framework analysis conducted by the International Co-operative Alliance – Africa (ICA), notes that

there are only few legislative provisions in these frameworks that promotes growth and development of co-operatives in Nigeria,[120] especially on transparency and good governance aspects.

Supporting tomato, onion and chili associations to improve on the issues mentioned above could be crucial to addressing food loss.

Chapter 4. Sustainability and CSR

4.1 People

From a social perspective, there are four main social issues that occur in the three value chains, namely Gender inequality, poor occupational health and safety, lack of youth inclusion, and child labour.

4.1.1 Gender Inequality

Specific data on gender inequality in Nigeria's tomato, onion and chili value chains is non-existent, nevertheless, the results from the Global Gender Gap Index 2020 provides a useful lens to better understand the nature of gender inequality in the country as a whole (which largely also applies to these three value chains). Nigeria is ranked at 128 out of 153 countries in the index. The ranking indicates a decline in Nigeria's ability to close its gender gap, as it fell by 5 places compared to the last ranking in 2018. Nigeria performs relatively better in offering comparable economic opportunities to both men and women than it does on the other dimensions of the index. The country has closed 73.8 percent of its Economic Participation and Opportunity gender gap to date (38th globally) and is one of the most improved countries globally on this aspect since 2018. Labour force participation, wages and income are low for both men and women, which has led to relatively positive gender parity outcomes that are however unsatisfactory from a human development point of view. For instance, average annual incomes are estimated to be close to USD 4,600 for women and USD 6,300 for men. These results indicate that it is crucial for programs or interventions in the three value chains to prioritize participation of women in value addition roles that would create income generation opportunities.

Overall, horticulture production and sale is still considered in Nigeria to be the purview of women. In most cases, women are expected to sell them in order to boost household income. Many women are saddled with multiple tasks and roles in their productive, reproductive and community obligations, which limit time for other viable and economic ventures that could be beneficial to them and their household. Women farmers generally have less access to land, inputs, paid labour, and extension services, and this means that they tend to grow more. but earn less in these VCs. Several researchers summarize two main constraints for women involvement in the three value chains:

1. *Access to land*: Women farmers are often deprived of direct land ownership in some Nigerian communities, particularly in the North. As a consequence, the have to hire land for farming activities, thereby increasing their production costs. It is well known that most lands used for horticulture production are inherited and it is rare that women inherit land.
2. *Limited access to credit facilities*: Inadequate access to flexible and affordable credit facilities by both producers and marketers (Isitor et al., 2016) is another constraint women face. Additionally, women are less likely than men to have access to collateral for formal credit.

Women in some producing communities in the North are only involved in the planting of seedling and up to harvest stage of production, particularly in the onion value chain; but in the Southern States (Ogun, Oyo and Osun states), women involvement in marketing and trading is significantly higher than in production. Several studies show that on average, about 80 percent of the marketing and trade of tomatoes and chili in these three states are done by women.[121] They are also involved in the retail sales of tomato, onion and chilli either on roadsides or in the local/community markets. The increasing commercial value of chili and its rising income potential is making more men interested in this value chain and will eventually create a competitive environment for women. Nevertheless, these value chains still create ample opportunity for women farmers to excel in production and marketing. The number of organizations, programs and projects focused on women is increasing. This will definitely impact the potential to improve opportunities and skills for women and to create jobs for women in these VCs. For example, the NEPC recently launched the SheTrades initiative in Nigeria together with ITC to improve export-related skills and unlock markets for women.[122]

4.1.2 Youth development

According to the AfDB (2016), each year, over 12 million African youths enter the labour market to compete for just 3 million jobs.[123] In Nigeria, nearly 25% of the general population is unemployed, 20% is underemployed and over 50% of youth aged 15 – 35 years are without work. In Nigeria, the proportion of youth aged 18–24 in the population is significantly higher than the global average, reaching almost 70 percent. While this population can be viewed as a great asset with vast potential, Nigerian youth are plagued by scant opportunities for their personal and professional development. Barriers include limited access to education; growing student dropout rates; rising unemployment, with a particular shortage of white-collar jobs; lack of access to finance for business initiatives—all at a time of heightened urban migration. This has led to growing masses of idle youth, who, in the absence of meaningful economic opportunities, threaten to destabilize the entire region as we have seen with the rise of Boko Haram.[124] Youth are engaged in sorting, sun drying (on the ground) and packing tomato and Chilli pepper. Report shows that some farmers pay young villagers about USD 83 to dry 300 baskets of tomatoes.[125] The study conducted by Oluwasola (2015) revealed a positive benefit-cost ratio (for every 100 Nigerian Naira invested on horticultural farming, 233 Nigerian Naira will be realized in addition to what was invested), which suggests that horticultural production in the country is profitable, and as such can be seen as a viable business opportunity for unemployed youths. Some relevant programmes targeting youth in the agricultural sector include:

- The Livelihood Improvement Family Enterprise (LIFE): Aims to contribute to job creation, value addition, and promotion of business enterprises in agricultural value chains, thereby increasing rural income generation and improved livelihoods for youths and women.[126]
- N-Power Agro: N-Power Agro is a government programme that will train qualified youths to provide advisory services to farmers across the country, to augment the existing low number of public agricultural extension service staff.[127]

4.1.3 Occupational Health and safety & Hygiene:

Production and packaging are still largely done manually using mostly hand tools in these value chains and since about 90 percent of farmers in these three value chains are smallholder farmers, they hardly utilize any basic personal protective gears. In industrial processing establishments, the majority of factory workers are casual labourers (or seasonal workers). They work mostly without any basic personal protective equipment (PPEs) like gloves or hair covers, gloves, or protective shoes during processing. Some processing factories are also operating under unsanitary conditions. In Nigeria labour inspectors hardly visit factories to assess the welfare of worker and other occupational working conditions. There are hardly any labour unions in these value chains, as most workers are only part of associations. Some of the main markets where tomato, onion and chili are traded locally are also operated in very serious unsanitary conditions.

4.1.4 Child labour

Despite the Child Rights Act (2013) and other regulatory instruments in Nigeria, Child labour is still widespread across Nigeria. This is largely because the regulations are both ineffective and are not competently implemented. Another main reason is that it is almost permissible in most Nigerian cultures for children to accompany their parents to labour-oriented work. In fact, in most cultures in the country, children are often perceived as "*economic assets, a basis for material wealth, possession and power, as they provide additional labour power for increased productivity*".[128] It is estimated that almost 15 million children are engaged in one or more forms of child labour in Nigeria, and around 85.2 percent are in the agricultural sector (including the tomato, onion and chili value chains). This is concerning, given that the sector is one of the most dangerous areas to work, based on occupationally related fatalities and other associated risks. Most working children are located in rural areas that have agriculture as the major occupation. Activities in the agricultural sector are physically demanding and strenuous, and mostly involves long periods of standing, repetitive and forceful body movements.

Children are easily seen carrying heavy baskets, and bundles of crops often over long distances. Others are exposed to dangerous work tools for weeding and harvest including heavy duty machines such as tractors. A large number of children work regularly on their families' farms, after school, during weekends or during holidays and in some cases, those that do not attend schools, work full time on the farms. Children are also seen in Nigerian streets hawking tomato, onions and pepper. Child street hawking or vendors in Nigeria is a significant challenge (including hawking of agricultural products). Studies indicate that by a 2:1 margin, female children are more likely to be involved as child labour in the agricultural sector than males. While male

children are mainly involved in field preparation, weeding and planting, the female children are involved in harvesting and processing of the products.

4.2 Planet

4.2.1 Climate Change and high resource use

Nigeria is the 55th most vulnerable country to climate change and 22nd least ready. Overall, climate change is projected to cost 6 – 30% of Nigeria's GDP by 2050, translating to USD 100 billion – USD 460 billion in losses.[129] According to FAO (2013), the production of lost and wasted food accounts for 173,000 – 250,000m^3 of water consumption per year (surface and groundwater resources) FAO, with approximately 24% of total freshwater resources being used in food crop production (27 m3/cap/year), and one-fifth of the fertilizers used for food crop production (4.3 kg/cap/year). The amount of cropland used to grow lost and wasted food is 198 million hectares per year, which represents one-fifth of the cropland used globally for food crop production, or an area about the size of Mexico (FAO,2013 and Lipinski et al., 2013). A reduction of food loss and waste will contribute to a decrease in land, water and nutrients use.

Food loss also contributes to climate change, being responsible for an estimated 8% of global GHG emissions (FAO 2015). According to CGIAR, in 2009 global wastage was responsible for roughly 3,300–5,600 million tons of carbon dioxide equivalent (CO_2e). According to FAO (2013), GHG emissions resulting from global food loss and waste are higher than any singular country in the world, except for China and the United States. Cereals make the greatest contribution to global food loss's GHG emissions, at 34%, followed by meat and vegetables (21% each).

According to FAO research on the full-cost accounting of food wastage footprint, social and environmental costs of food loss globally are estimated at USD 700 billion and USD 900 billion respectively. Key salient environmental and social costs of food wastage include:[130]

- 3.5 Gt CO_2e of greenhouse gas emissions. Based on the social cost of carbon, these are estimated to cause USD 394 billion worth of damages per year.
- Increased water scarcity, particularly for dry regions and seasons. Globally, this is estimated to cost USD 164 billion per year.
- Soil erosion due to water is estimated to cost USD 35 billion per year through nutrient loss, lower yields, biological losses and off-site damages. The cost of wind erosion may be of a similar magnitude.
- Risks to biodiversity including the impacts of pesticide use, nitrate and phosphorus eutrophication, pollinator losses and fisheries overexploitation are estimated to cost USD 32 billion per year.
- Increased risk of conflict due to soil erosion, estimated to cost USD 396 billion per year.
- Loss of livelihoods due to soil erosion, estimated to cost USD 333 billion per year.
- Adverse health effects due to pesticide exposure, estimated to cost USD 153 billion per year.

Ultimately, less food loss or waste in tomato, onion and chili value chains means more efficiency and a higher net output and productivity of land, water, transport, and less import. This will reduce the environmental footprint of each of the value chains.

4.2.2 Overuse of pesticides

Farmers overuse pesticides, sometimes they use different products with the same function, because they are unaware of the product details and specifications and agro dealers are bent on selling a lot of products, so they sell two products that do the same and then advise to mix them. Sometimes, commercial sellers of crop protection products advice farmers out of ignorance. This leads to misuse and can have devastating consequences for the crops and the environment. In addition, farmers are sold counterfeit products instead of genuine crop protection products.

4.3 Profit

4.3.1 Fair and clear agreements

Due to poor education and lack of business skills, smallholder producers in Nigeria often do not insist on establishing formal agreements with their local buyers and thus they are prone to exploitation by traders or middlemen.

4.3.2 Market infrastructure

The market architecture of the three value chains is not well structured or organized and as a result, brokers (middlemen or traders) emerge as a dominant actor of these value chains (this is especially visible in the onion

value chain). These brokers often have no license and as the market is an informal one, they often do not pay taxes to the local authority and they are not held accountable.

4.3.3 Market power

Many smallholder producers lack market power as it is in the hands of traders who control the markets. This makes producers vulnerable actors. The regional traders play a very crucial role, in that, they buy the products from the famers, but at the same time, they also supply seeds and fertilizers to the farmers. Most smallholder farmers are poor and often lack funds to purchase seeds and fertilizers. For example, in the onion value chain, the farmers negotiate to trade in their onions for these inputs, to be provided by the traders. Onion farmers are therefore very much financially dependent on these traders. Farmers are also unaware of the price dynamics of onions and as such most traders take advantage of this.

4.3.3 Corruption

Corruption is a pressing issue in Nigeria. The corruption index for Nigeria from Transparency International indicates that Nigeria is among the most highly corrupt countries of the world. This situation has not changed, despite the fact that President Muhammadu Buhari launched an anti-corruption drive after taking office in May 2015. Interviewed stakeholders expressed that at almost every part of the value chain, acts of corruption are visible.

Chapter 5. Key Opportunities and Interventions

This chapter provides an outline of the key opportunities and interventions. The overviews below outline the main opportunities and possible solutions (as identified by local stakeholders) in the value chain of tomato, Chilli and onions, that lead to losses and wastes in the chains.
As part of a "Global Action Agenda for reducing the rate of food loss and waste", in 2019, the World Resources Institute (WRI) summarized some of the emerging developments in reducing food loss (and food waste) in value chains, see figure 14. WRI also recommends that to address food loss and food waste in value chains, governments and private sector actors should apply the "Target-Measure- Act" approach (an actor-specific "to-do" list, and 10 "scaling interventions"), see figure 15. Most of the interventions recommended to RVO in this report are in line with the WRI agenda.

Figure 14: Summary of Emerging developments to Reduce Food Loss and Waste across the Supply Chain
(Source: WRI, 2019)

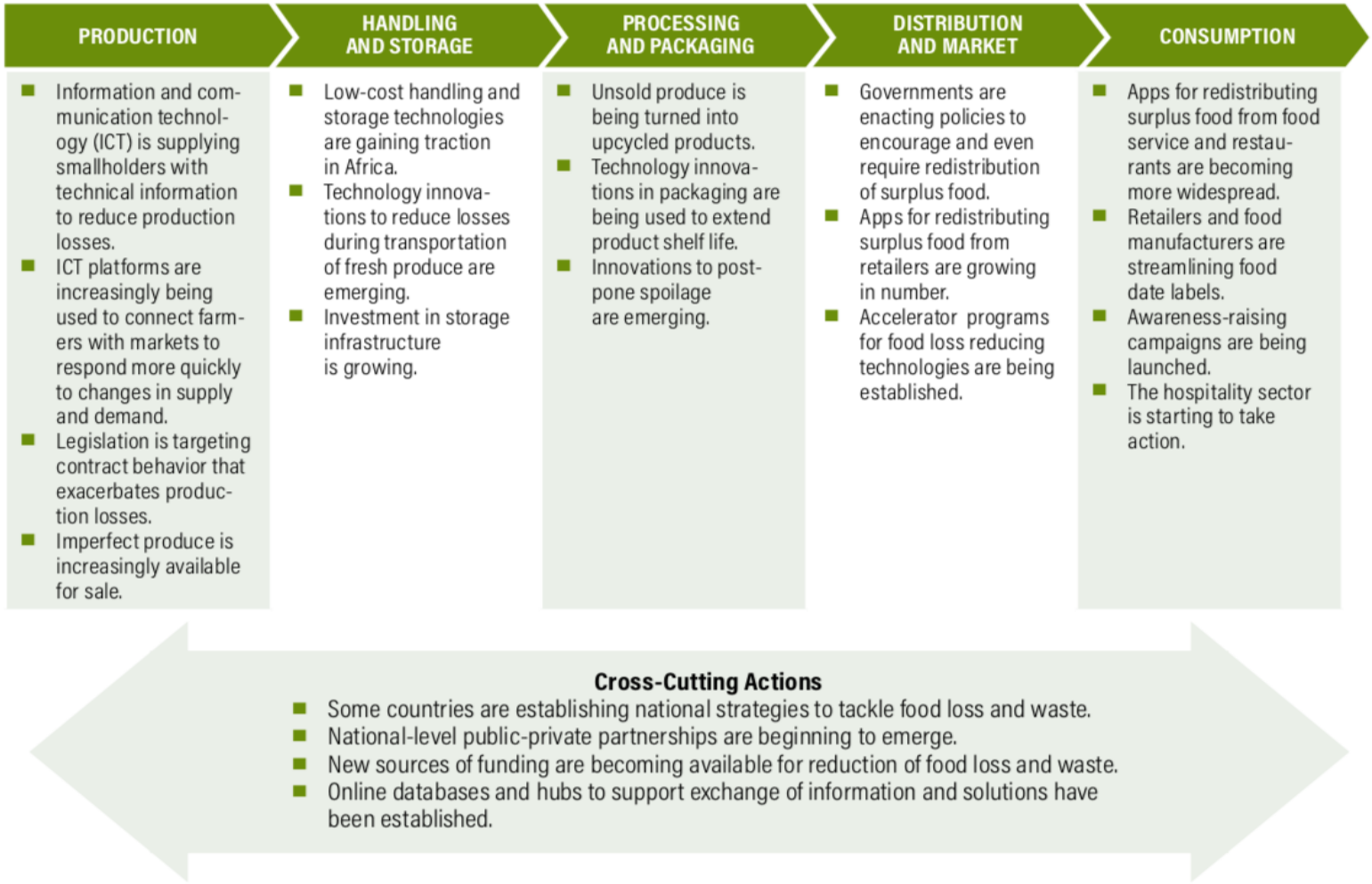


Figure 15: Summary of WRI's "Target – Measure - Act Approach" for Reducing Food Loss and Waste
(Source: WRI, 2019)

Target – Measure - Act Approach

10 possible scaling interventions that have the potential to accelerate and broaden deployment of the Target-Measure-Act approach and deployment of the needed actor- specific interventions. Three of them take a whole supply chain approach, four of them target specific hotspots of food loss and waste, and three more enhance some of the enabling conditions for reducing food loss and waste. They may not constitute a comprehensive set, but they are a start.

Whole supply chain approaches

1. **Develop national strategies for reducing food loss and waste.** Increase the number of countries with national strategies, as these can be an important catalyst for Target-Measure-Act at the country level—aligning public policy, private sector action, and farmer-to-consumer behavior toward a shared goal.
2. **Create national public-private partner- ships.** Increase the number of country-level public-private partnerships dedicated to achieving SDG 12.3.
3. **Launch a "10x20x30" supply chain initiative.** Launch a voluntary private sector campaign where at least 10 corporate "power players" commit to Target-Measure-Act them- selves and then engage their own 20 largest suppliers to do the same.

Hotspot-specific approaches

4. **Invigorate efforts to strengthen value chains and reduce smallholder losses.** Invigorate efforts to help smallholder farmers reduce food losses during production and storage.
5. **Launch a "decade of storage solutions."** Kick-start a focused collaboration among storage providers, cold chain alliances, financiers, and governments to get income-sensitive, climate-smart storage technologies into the hands of farmers and distribution networks around the world.
6. **Shift consumer social norms.** Leveraging the latest findings of behavioral science, engage grassroots campaigns, social media, religious communities, and others to make "wasting food" as unacceptable as littering now is in many countries.
7. **Go after greenhouse gas emissions reductions.** Use sector-led programs to tackle food loss and waste from beef, dairy, and rice head on, and get the reduction of food loss and waste into nationally determined contributions to the Paris Agreement on climate change.

Enabling approaches

8. **Scale up financing.** Develop funds and financing products dedicated to investing in innovating and scaling up enterprises, technologies, and programs designed to reduce food loss and waste.
9. **Overcome the data deficit.** Over the next five years, a concentrated push to measure food loss and waste is needed to overcome this data deficit in time to support achievement of SDG 12.3.
10. **Advance the research agenda.** More research is still needed to answer multiple "next genera- tion" questions that would, in turn, help refine food loss and waste reduction strategies and advance implementation of the global agenda.

5.1 Existing initiatives to reduce VC food loss in Nigeria

Relevant Policies / Programmes	Description	Value Chain	Developed by
- Nigeria Policy on Solid Waste Management (2018) - Nigeria Agricultural Waste Policy	- Only recently (in July 2020) has Nigeria updated its national Solid waste management Policy. The government expects the policy to provide a framework for the integration of efforts by the federal, state and local governments, ministries, departments and agencies, non-governmental organisations (NGOs) and other stakeholders, on waste management. The new policy document takes into account the wastes generated from agricultural production but lacks depth. - A separate Agricultural Waste Management policy is currently in draft.	General and Agriculture	- The Federal Ministry of Environment, working in close collaboration with the United Nations Industrial Development Organization (UNIDO) coordinates the development of the National Policy on Solid Waste Management - The Federal Ministry of Environment.
Tomato Policy	The Nigerian Government announced in 2017 that it will reduce the amount it spends on importing tomato as part of its National Industrial Revolution Plan and in line with its objective of boosting tomato production, improving the value chain and attracting foreign investment. a new policy to encourage local production and processing by increasing the tariff on importation of tomato concentrate to 50 per cent alongside an additional levy of USD 1,500 per metric ton. It is said that the implementation of the tomato policy has not been successful. The main measures of the tomato policy are indicated in section 3.5.5.	Tomato	Federal Government of Nigeria.
CBN Anchor Borrowers' Programme (ABP) 2016-2020	CBN's Anchor Borrower's Programme is aimed at creating a link between off-taker companies involved processing and smallholder producers of some agricultural commodities. Tomato is one of the targeted commodities.[131] Onions and Chili are not mentioned (although some farmers in these VCs appear to have benefited due to dual cultivation). In the 2019/2020 dry season, the farmers, aided by a loan acquired through the Central Bank of Nigeria's (CBN) Anchor Borrowers Programme, farmers from TOGAN purchased thousands of plastic crates. Before the purchase of the crates, the farmers used raffia baskets to store and transport tomatoes, causing a loss up to 45 per cent of the produce. This loss comes in the form of breakages. However, since the introduction of crates, the loss has been reduced by at least 20 per cent.[132] 600 farmers of Nsukka yellow pepper species have been shortlisted to benefit from the Anchor Borrowers Program of the Central Bank of Nigeria.[133]	Tomato	Tomato Out Growers Association of Nigeria (TOGAN), CBN
Nigerian Stored Products Research Institute (NSPRI) claims to have environment-friendly patented technologies that can reduce post-harvest losses.	NSPRI conducts research to reduce Postharvest losses by ensuring the quality, safety and availability of Agricultural Produce. NISPRI has developed several locally made technologies to solve the challenge of post-harvest losses, e.g., evaporative coolant system for fruits and vegetables, stackable crates for tomatoes, cane baskets for keeping vegetables fresh.[134]	Tomato (and Agricultural products in general)	Nigerian Stored Products Research Institute (NSPRI)
Various Nigerian Government initiatives	Agriculture Promotion Policy (APP) or Green Alternative; the Growth Enhancement Support (GES); Agricultural Credit Guarantee Scheme Funds (ACGSF); Commercial Agriculture Credit Scheme (CACS), and Nigeria Incentive-based Risk Sharing System for Agricultural Lending (NIRSAL).	Agriculture in general	Federal Government of Nigeria, Federal Ministry of Agriculture (FMARD) World Bank, Africa Development Bank

Relevant Policies / Programmes	Description	Value Chain	Developed by
	In addition to these programmes are world bank funded projects which also involves the Federal Government of Nigeria and participating states, African Development Bank and World Bank Funded Rural Agricultural Access and Marketing Project (RAAMP), (which is in the third phase). The Agro Processing, Productivity Enhancement and Livelihood Improvement Support – APPEALS Project is a 6-year project developed by the Federal Ministry of Agriculture and Rural Development (FMARD) in collaboration with the World Bank and other stakeholders		
YieldWise program	Addressing food losses in tomato production by promoting cottage processing to increase the shelf life of tomatoes and optimizing production through training. Within this program TechnoServe is supporting value-addition activities along the tomato value chain (providing equipment and certification), which, together with other project initiatives, will contribute significantly to reducing post-harvest losses, curtail the reliance on imported tomato products, and generate direct and indirect employment for women and youth.[135] TechnoServe has also developed climate-smart techniques to reduce postharvest losses.[136] The Rockefeller foundation has launched YieldWise, a $130 million initiative to demonstrate how sub-Saharan Africa can cut post-harvest losses in half by 2030. The initiative, which is 7-year programme,	Tomato	Technoserve, Rockefeller Foundation
Postharvest Loss Alliance for Nutrition (PLAN)	PLAN was developed as a tool to address the loss and waste of nutrient dense perishable foods and will begin by targeting horticulture crops, which are typically some of the most nutritionally dense foods in the human diet. Nigeria was selected as the first PLAN country due to its high potential for impact and enabling environment for successful implementation of solutions that address both postharvest loss and micronutrient malnutrition. PLAN focuses primarily on three key postharvest issue areas in the nutritious foods value chain: packaging and crating, cold chain storage/ logistics, and food processing.[137]	Tomato, Pepper, onions (Horticulture in general)	GAIN
Cold Storage Hubs	Partnership between feed the future and ColdHubs Limited, to establish 20 new, affordable cold storage rooms at 10 sites (or "hubs") near marketplaces and farmer clusters across Nigeria. As walk-in, solar-powered units, ColdHubs' cold storage rooms are designed to preserve perishable foods as well as increase the shelf-life and value of products. Using a pay-per-use model, customers are charged for each 20kg crate of produce stored per day. At full capacity, each cold storage room holds 150 crates and serves 200 customers per day, with customers storing and withdrawing their produce at different times. To date, eight cold storage rooms have been established at four market hubs (two rooms at each hub) across the country. [138]	Horticulture in general	Feed the Future and ColdHubs Limited
Nigeria Competitiveness Project (NICOP)	NICOP focuses on: • Large/medium/small scale processors to promote additional products, processing forms, improve efficiency and market linkages. • Strengthen farmer and buyer organizations with better business practices, standardization and market linkages.	Tomato and Chili	EU, GIZ, Federal Ministry of Agriculture (FMARD)

Relevant Policies / Programmes	Description	Value Chain	Developed by
	• Work with research institutions to test and promote new varieties, • Strengthen capacity on pest control/farming practices to improve yields. Focus states are Kaduna, Kano, Plateau, Kebbi, Oyo, Ogun and Lagos. Duration August 2018 to July 2022[139]		
Growth and Employment in States – Wholesale and Retail Sector (GEMS4)	GEMS4 introduced Good Handling Practices (GHP): introduced over 25,000 Returnable Plastic Crates (RPCs) and set up a crate rental model linked farmer to two tomato processing plants mapped tomato clusters, facilitated new rail transport and packaging methods. The project ended recently (duration was 2012 – 2017). Although, it appeared successful, the project noted that adoption (i.e., shift from raffia baskets to Returnable Plastic Crates (RPCs)) was quite slow because it is difficult to readily change people's behavior and practices.	Tomato	Project was funded by UKaid Department for International Development (DFID)
Food Africa	The Food Africa joint programme reached 246 farmers and 15 cooperatives and farmers groups over six months. They benefited from skills trainings, and access to agricultural inputs and equipment, which improved their productivity and minimized post-harvest losses. Farmers' access to an improved agro-processing facility was supposed to be done through building a local food processing facility by the private sector partner. Project was partly funded 21% by the SDG Fund. Total budget was USD 2.5 million	Tomato	Project partners: FAO, ILO, ITC National partners: Federal Ministry of Agriculture and Rural Development, Federal Ministry of Water Resources, Kaduna State Government, local NGOs, rural farmers and women
Toward Sustainable Agribusiness Clusters through Learning in Entrepreneurship (2SCALE) project	The IFDC/2SCALE project is collaborating with Tays Foods Limited (TFL) in Nigeria and the World Vegetable Center to work with onion farmers, traders, and other onion value chain actors to ensure more of the onion harvest makes its way to markets and consumers—and ultimately more income accrues to producers. TFL intends to build over 700 metric tons of onion storage and processing facilities for white onion powder production. To provide farmers improved inputs, such as seeds and fertilizer, and to then buy the product to supply its markets. In 2018, 2SCALE piloted white onion production with TFL. One year later, the pilot had been developed into a full-fledged partnership in order to scale up the production. 2SCALE brought farmers together in eight groups across Sokoto State and built their capacity via establishment of demonstration plots, dedicated to learning best practices on the cultivation of the white onion variety. The improved seeds are supplied by Bejo Zaden, a Dutch vegetable seed company that will provide onion seeds to be cultivated by the 5,000 target farmers of the partnership and provide them with basic training and coaching. About forty days after the application of the seed, farmers were impressed by the level of germination.[140]	Onions	IFDC /2 SCALE, Tays Limited, World Vegetable Center The project is funded by DGIS-Netherlands and implemented jointly by IFDC, the BOP Innovation Center, and SNV
Cold Chain solutions (Rerfrigerated Truck Transport)	Together with Naija Pride, APM Terminal is working to provide modern cold chain transportation alternatives for farmers in the agricultural centers of northern Nigeria to bring fresh produce intact and unspoiled to market centers in Lagos. APM Terminal intends to use cold chain transportation to demonstrate ways in which efficient transportation means can be used to reduce post-harvest losses and extend the shelf life of fresh	Tomato	APM Terminals partnered with Naija Pride for the tomato shipment, in cooperation with US-based TechnoServe.

Relevant Policies / Programmes	Description	Value Chain	Developed by
	produce to local consumption and export. Recently, the first pilot shipment of 18.6 metric tons of fresh tomatoes, packed into 933 crates each containing 20 kg, were loaded into a refrigerated container for the 1,045 km (650 mile) trip from Kaduna to Lagos. In the controlled reefer environment, heat spoilage, as well as bruising damage from cargo shifting during transport was eliminated – and the entire truckload arrived intact and ready for sale or further transport.[141]		
Reducing post-harvest loss project	The project applies a communication strategy encompassing radio, television, cellphones and mobile videos to bridge the gap between farmers' awareness and adoption of improved farming practices as well as technologies that reduce post-harvest loss.[142]	Tomato	Farm Radio International and partners Access Agriculture and Media. The project started in 2018 and is supported by The Rockefeller Foundation through its YieldWise initiative.

5.2 Initiatives by Dutch companies

The table below provides an overview of some of the companies doing business in Nigeria, targeting the food loss and in these value chains, their activities, partners and their expressed experiences or opportunities.

Dutch Companies & Partners	Value Chain/Activity	Experiences and Opportunities
East-West International B.V Transforming Nigeria's Vegetable Markets Partners: Netherlands Enterprise Agency (SDGP), Federal Ministry of Agriculture and Rural Development (FMARD), Ahmadu Bello University, Zaria.	**Tomato, Onion, Chili** East West International and partners aim to disseminate knowledge and introduce new and improved vegetable seed varieties in rural Nigeria (Kano and Kaduna States)	RVO (via its SDG Partnership Facility) is supporting the dissemination of GAP knowledge and introducing new vegetable seed varieties in rural Nigeria (Kano and Kaduna States). [143] *Experiences in Nigeria* • Targeting food losses starts already from the sort of seed varieties farmers are using. • There are varieties which can have longer shelf life. Extending shelf life through hybrid varieties can be interesting for tomatoes and onions. • Farmers don't have cold storage or logistics. That is where extending shelf life can help. We also work on increasing yield, when the yields are high, the effects of losses in other parts of the chain are less problematic. It compensates the losses. Pepper and onion are not as critical as tomato. We mainly use the African Habanero pepper, which is resilient. Pepper is mainly transported dry. Dried by the farmer and has a good storability in which it can stay good for over a month. During the drying process the issue of Aflatoxin could occur, during sun drying. Onion doesn't get bad as fast as tomato. Most onions would at least store for a month. Farmers don't look at the input and output. They look at the number of baskets they harvest, from which they extract if they are doing well or not. But they don't look at the cost margins. We help them with this. And we show them that their harvest doesn't necessarily depend on the number of hectares they have, they can downscale it with good seed inputs and the yield per square meter increases and improving quality - compared to how they used to do it before. Sometimes they even get a premium price on the market (based on the color, case, size and shelf life). Opportunities for addressing food loss. • East West International are now looking in Nigeria to develop an onion variety that can be stored longer, like they did in the Philippines. • For tomatoes, East West is looking into breeding varieties with a thick skin that can withstand the rigors of rough transport, handling and distribution processes in Nigeria.

Dutch Companies & Partners	Value Chain/Activity	Experiences and Opportunities
Bejo Zaden Partner: Tays Food Nig. Ltd.	**Onion value chain** Bejo Zaden Supplies improved onion seeds to Tays In Nigeria	Good partnership with Tays for almost 3 years. Main challenge is that only small orders can be made since Nigerian bureaucracy and corruption creates bottlenecks for large orders. Reasons for food losses in the onion vc can be summarized as: • There is only one main season with harvest in April – May resulting in an enormous peak in supply. • A nearly complete lack of storage possibilities to store this peak and spread the sales over a long period • The lack of financing possibilities makes it difficult for farmers to invest in better growing techniques and storage facilities • The production is still mainly small-scale and locally organized, not suitable for large scale nationwide distribution and trade nowadays • In this value chain the local traders still have a dominant role as financers, input suppliers and information source for the farmers. Their interest is dependency of the farmers so no motivation for development. • Lack of knowledge • There is a corrupt patronage system that blocks local innovation. It is very actively counteracted when one does not place an incentive on the right places. • Simple storage sheds must be present, the onions cannot remain in a pile on the field. Investments must be made in this. Then you have to make sure that good quality products get into storage, and you have to arrange that in the field.
Agrofair Benelux B.V	**Tomato** AGRILOGISTICS – Nigeria. Improving Inland Transport Modalities for Vegetables and Food Crops between Production Zones, Urban Conglomerations and Export Hubs", financed by the Multi-Donor Trust Fund for Sustainable Logistics (MDTF-SL), administrated by the World Bank.	Officially, the project started in April 2017, with the signature of the contract between the World Bank and Agrofair Benelux B.V. Agrofair and partners have conducted several missions to Nigeria. Based on the outcome of these missions, their observations and solutions are summarized below: • Farmers are in need of technical support to improve tomato production (i.e., seed, fertilizer, planting method, harvest technique and timing etc.), understand the market requirements and improve engagement with traders, for example on the varieties required • Productivity is low, and farmers are unable to invest in the postharvest side of their operation, because the capital is tied up in production. • Handling of produce from production site to market and within the market would be a primary contributor to postharvest losses. Crate adoption and penetration is still very low. Handling within the market is a challenge where a lack of phytosanitary regulation/standards prevails, where a lack of market infrastructure to support any of the recommended good handling protocols is evident and the limited buy-in from market governing bodies is quite apparent. • There is an apparent disconnect between supply chain actors and supporting institutions mandated with promoting good handling practices for fresh produce in the chain • Taking into consideration the needs of the various actors in the chain, clear definition of roles and ownership is needed for effective implementation of any solutions. The traders haven't been fully convinced of the incentive of using crates, haulers are not involved in adoption of crates because it doesn't influence their revenue, farmers' buy-in for crate distribution is fairly straight-forward but they must also be convinced of a price incentive • The governing body in the markets must be convinced that the crate use will not disrupt their current business negatively. Bringing together all these actors, defining responsibilities and actor needs, is therefore important to design a customized intervention. • Organisation of farmers is a major challenge as there is a lot of distrust in the chain. • In Kano, Plastic crates are scarce; apparently these are used especially when there is high demand and high supply of tomatoes. Another

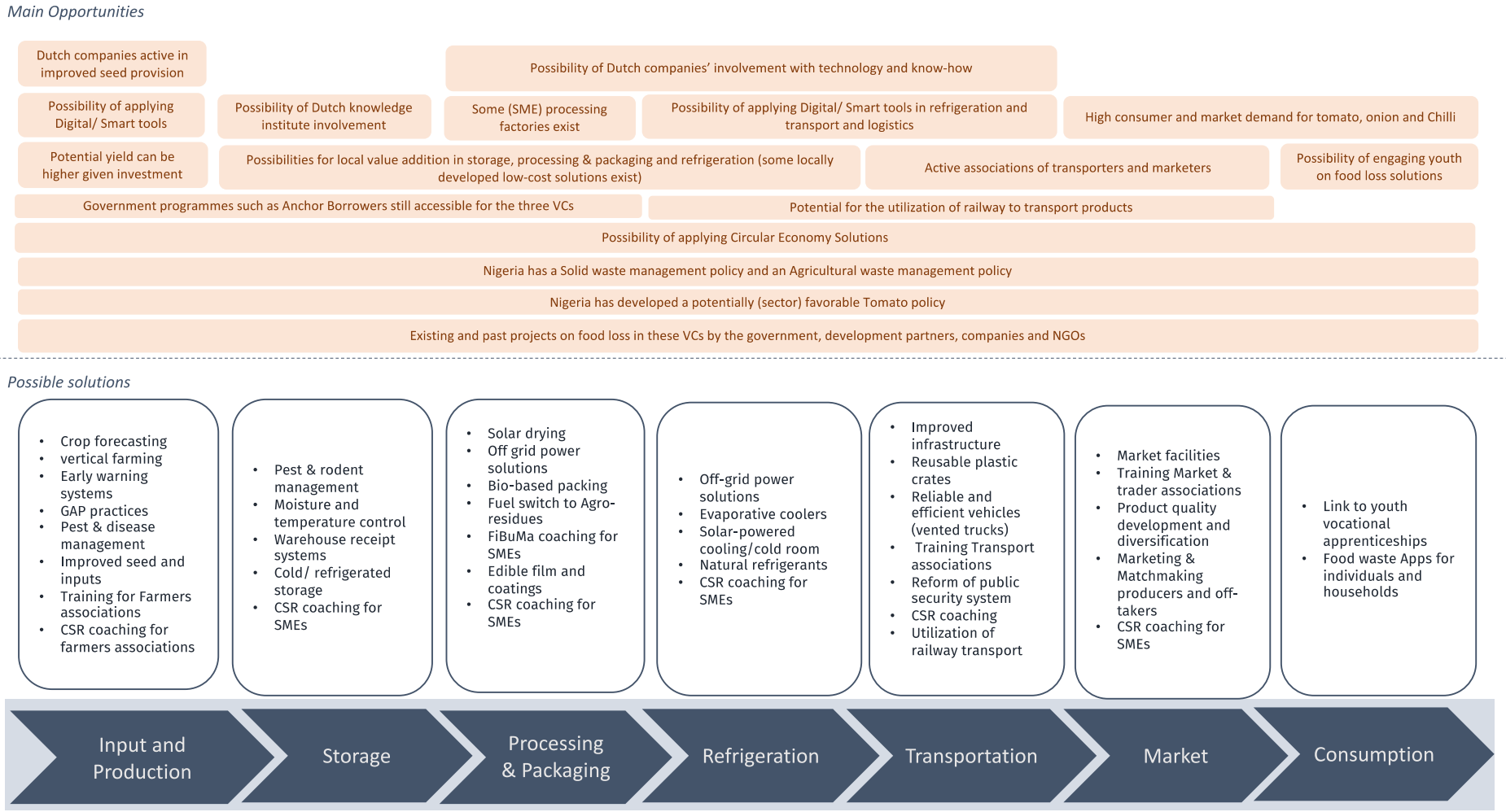
Dutch Companies & Partners	Value Chain/Activity	Experiences and Opportunities
		limiting factor: the transport cost of bringing back empty crates. Crates usually come back empty, there is no suitable produce (or supply chain connections) to transport fruit and vegetables from the South to the North (such as pineapple, banana). • Low grade tomatoes (class 3 and 4) are cut into two and sundried on bare floor on the market, open to dust and dirt. ***Solutions/ opportunities:*** • In the pilot projects two innovations were tested: the introduction of returnable plastic crates to pack and transport the tomatoes, and the use of raised platforms for improved sun-drying of tomatoes. Both innovations had a positive effect on the reduction of post-harvest losses and were widely accepted and welcomed by different stakeholders. • In principle, transport of tomatoes via rail is a good idea. • Improved logistics schedule for delivering tomatoes in non-refrigerated vehicles e.g., harvesting in the late afternoon and transporting in the evening to take advantage of ambient cool conditions. • Use of appropriate size containers to prevent overloading of produce e.g., offering a variety of crate sizes to fit different volume needs across the chain - Use appropriate plastic crates with sufficient ventilation slits • Haulers played no major role in packaging of tomatoes, with only 20% claiming involvement in re-packaging during the haulage operation. Ownership of packaging therefore rests with the producers and traders and these should be the target for packaging interventions such as crates. • Actors involved in provision of technical support to farmers are encouraged to deliver improved extension services, with information and training on fertilizer use and irrigation scheduling. • Improved harvest timing. Harvesting at later ripening stage is possible if the distance (and transport) to market is not a major challenge • Improved seed variety, suitable for the agro-climatic conditions in the area, with appropriate shelf-life characteristics is needed.
NABC Partners: NABC Seed4Change program involves 7 seed companies such as: NABC plays a central role of coordinating this program, the joint objective of the involved companies Cluster members are Syngenta, EnzaZaden, Bakker Brothers, Rijkzwaan, Koppert, East West Seed, Project Partners include: Wageningen University, 2Scale, Afri Agri Products, Ltd., Bayero University Kano (BUK).	**Tomato, Onion and Chili** Currently in Kano - in collaboration with Dutch seed business - set up seed breeding projects	NABC Seed4Change program (funded 50% by RVO via PSD Toolkit and 50% by the seed companies) is already running in Nigeria, with a cluster of 7 companies that are active in horticulture seeds (watermelon, onion, chili pepper, tomatoes, etc.). These Dutch seed companies have united to share knowledge and common interest and jointly start operating in Kano to set up a breeding seed development program, that must result in higher crop yields with their seeds. Increasing the harvest with three to five times. The seeds are developed in such a way that they are resilient to the weather conditions in Kano. The initiative focuses on: • 5 vegetables: tomato, onion, cabbage, watermelon and pepper. • Provision of high-quality input materials (e.g., hybrid seeds and biological crop protection); • Demonstrations & knowledge transfer via farmer-to-farmer training, farm field days and on-farm workshops. • Connecting small and medium-scale farmers to off-takers and financiers. Solutions/Opportunities RVO and CBI could think of combining a group of companies, in the way that NABC have combined those seed companies, that are working in providing secondhand equipment, or food processing companies with specific knowledge and expertise. Making a cluster to do something very focused in a specific region where the 3 VC are operating
APM Terminal Partners: APM Terminals partnered with Naija Pride for the tomato shipment, in cooperation with US-based Technoserve.	**Tomato** (Pilot) Horticulture in general. The project focuses on providing Cold Chain solutions (Refrigerated	Recently, the first pilot shipment of 18.6 metric tons of fresh tomatoes, packed into 933 crates each containing 20 kg, were loaded into a refrigerated container for the 1,045 km (650 mile) trip from Kaduna to Lagos. In the controlled reefer environment, heat spoilage, as well as bruising damage from cargo shifting during transport was eliminated –

Dutch Companies & Partners	Value Chain/Activity	Experiences and Opportunities
	Truck Transport) for perishable food products.	and the entire truckload arrived intact and ready for sale or further transport.
2Scale Partners: The project is funded by DGIS-Netherlands and implemented jointly by IFDC, the BOP Innovation Center, and SNV	**Tomato, Onion and Chili**	2SCALE is an incubator program that manages a portfolio of public-private partnerships (PPPs) for inclusive business in agri-food sectors and industries. 2SCALE offers a range of support services to its business champions (small and medium enterprises [SMEs] and farmer groups) and partners, enabling them to produce, transform, and supply quality food products. These products go to local and regional markets, including to base-of-the-pyramid (BoP) consumers. • For these VCs, 2Scale is working with two champions: Tays Nigeria Limited on improving the productivity and the reduction of the post-harvest losses in the onion value chain in Sokoto state. • EVERGREEN aims to support vegetable smallholder farmers connecting them to the farmer academies for sustainable vegetable supply to SPAR superstores.
Rijkzwaan Rijk Zwaan has 4 offices in Africa: South Africa, Morocco, Egypt and Tanzania. In Nigeria they are not active themselves but work with a (field) distributor.	**Tomato and Chilli pepper** Rijkzwaan supplies hybrid seeds that are distributed by their local partner. The company claims that it has proof that the hybrids yield more than the existing varieties for local parties, also from a financial and economic standpoint. The hybrids cannot be propagated and as such has to be bought every year. But Rijkzwaan believes that they give 3-4 times more yield, which makes them affordable.	Rijkzwaan is one of their markets, but they have not been active in Nigeria for the last 3 years. They always scan new countries and markets, with growth potential, a horticultural culture and a lot of suitable land for growing vegetables. Rijkzwaan believes that Nigeria fully fulfils these criteria. In addition, Nigeria has a young population that consumes high amounts of vegetables (including tomato, chili and onions). The only doubts they have is regarding the country's political stability and corruption. To mitigate this, it is essential to have a trusted local party that knows the market better and who already is based in the country. In any case, Nigeria is a country with enormous potential and Dutch more Dutch companies should become active in the country, notwithstanding (or being conscious) of the risks. ***Solutions/ Opportunities*** For tomato and chili value chains, it is essential to support the training of smallholder farmers, knowledge transfer on seeds It is important to consider replicating successful RVO funded projects in other countries such as Seeds of Expertise for the Vegetable Industry of Africa (SEVIA). SEVIA will provide farmers with access to practical knowledge, skills and information about vegetable production and marketing, free of charge, including a combination of improved seed genetics and improved technologies. A project like this would be useful in Nigeria. Utilize local experiences and consider local conditions prior to any intervention. So, a holistic approach is important. One short term intervention in only one part of the chain will most likely not solve food loss or waste in the tomato and chili value chain. The most important impact will be on how to realize a higher input per hectare. Smarter cultivation, maximum use of available soil, better seeds, drippers, fertilizers, correct application of pesticides, will ultimately contribute directly or indirectly to less food loss in tomato and chili value chains.
Stichting Wageningen Research Partner: RVO	**Seed Sector Review Nigeria.**	The project financed by RVO (via PSD Toolkit programme) has an overall objective "to review the Nigerian seed sector to enable an informed discussion on the development of the envisaged seed sector development programme in Nigeria. The seed sector review will focus on the enabling environment for the seed sector in Nigeria. Accordingly, a seed sector development roadmap will be formulated in cooperation with all relevant Nigeria stakeholders".[144]
Wageningen Food & Biobased Research **Partner:** Agrofair, N-N-Solutions and the International Fertilizer Development Centre (IFDC).	**Tomato** **Food Loss and Waste Measuring** The purpose of the Food Loss and Waste (FLW) measurement is	This research project was implemented by Wageningen Food & Biobased Research commissioned by the Dutch Ministry of Economic Affairs. Some of the findings were: • Increasing the quality of tomato at farmer level will decrease the percentage of loss in the value chain.

Dutch Companies & Partners	Value Chain/Activity	Experiences and Opportunities
	to assess the performance of the tomato VCs when using traditional product packaging, the raffia baskets, in comparison with the intervention with plastic crates.	• There were fewer losses in the VC when plastic crates were used (i.e., plastic crates showed better results compared to the traditional raffia baskets) • transportation time due to police controls, broken vehicles, closed roads or distances to the market and production circumstances such as different seed varieties, use of fertilizers, use of sheds, etc., can have influence on tomato losses in the chain.[145]

5.3 Key Opportunities and Solutions

Figure 15: Summary of opportunities and possible solutions



5.3.1 Possibility of applying Circular Economy solutions

As described in this report, food losses can be significantly minimized through improved input, adoption of GAP, improved harvesting techniques, better handling and storage of harvested crops, and the adoption of cold-chain logistics, amongst others. In addition to these, studies show that CE approaches could also be applied in addressing food losses, including valorizing unmanaged surplus, inevitable losses, as well as side streams during processing that lead to wastes,[146] and the beneficiation of agricultural and food waste for energy and soil conditioning. [147]

According to a report from Holland Circular Hotspot (HCH), the term "circular economy" is a little-known concept in Nigeria; however, the concept seems to suit the resilient and innovative culture of the country. Based on its mission to Lagos State Nigeria in 2019, HCH notes that there are many examples, that show the variety of ways in which CE is already taking shape in the country. Two CE platforms noted by HCH are: *Nigeria Circular Economy Working Group (NCEWG)* - established by the Federal Government of Nigeria and the AfDB with the aim of developing a Circular Economy Roadmap for Nigeria; and *African Circular Economy Alliance (ACEA)* – "serves as a centralized platform for knowledge- sharing and best practices identification, the creation of enabling legal and regulatory frameworks, as well as building partnerships for financing and creation of circular economy projects in Africa". [148]

However, so far, CE solutions for the agricultural sector, mostly target the beneficiation of organic wastes from consumers and industries (e.g., producing high protein animal feed from insects using organic waste as the main input),[149] and recycling of food packaging. CE solutions for unmanaged surplus or inevitable losses in the chain still needs attention. Therefore, there is need to explore the possibility of stimulating CE approach to address food losses in Nigerian food value chains (with accent on the selected three VCs – tomato, onions and Chilli). Food losses could be adopted to develop bio-economy opportunities such as animal feed production, (liquid) fertilizers, and new biomaterials from agricultural byproducts. [150]An EU commissioned research (2020) affirms this, noting that the agri-food sector needs to be central to Nigeria's CE pathway, given that the sector is a major source of income and jobs in the country. Their research further notes that "adoption of CE principles could act as a driver to promote food security and increase productivity in the agriculture and food production sector". [151]

Modelling done by Trinomics estimates the potential benefits/impacts of circular economy activities in Nigeria, thus:

- "A 3.2% increase of GDP (+ €15.2 billion) compared to business as usual.
- An improvement of the trade balance, through a reduction in imports worth € 4.4 billion.
- Food loss reduction across the agricultural value chain and associated investments (these are the largest driver of the impacts found in our modelling assessment).
- 1.6 million additional jobs would be created compared to business as usual, which is equivalent to an increase of 3.9%.
- If done in the right way, increased activities in waste collection and recycling could strengthen the economic position of (informal) waste workers, and attention for capacity building and training can ensure that these people will benefit from the CE transition as well.
- The largest employment increases are found to occur in agriculture, services (largely driven by waste management), distribution, retail and manufacturing. The largest job loss occurs in the chemicals sector, due to product substitutions".

Some documented examples or inspirations of the application of CE solutions to address food losses, which could be explored in Nigeria, include:

- Duijvestijn: A Dutch-based tomato company Duijvestijn shows example of CE innovations for valorizing tomato surplus, by developing a sustainable drying oven that is used to slowly dry surplus fresh tomatoes and converting them to new high-end products (such as dried tomatoes and tapenades). [152]
- WiSErg : A US-Based company, "WisErg transforms food scraps and food surpluses into organic fertilisers. WiSErg 'Harvesters' are placed at food service facilities where the Harvester processes food scraps in a self- contained system. During the transformation process, valuable nutrients are captured and stabilized. The resulting material is transported to a nearby facility where it is processed into liquid fertilizer". [153]
- Re- Nuble: "creates an organic liquid nutrient that is derived from vegetative waste for hydroponic growers and traditional gardeners".[154]

- Other examples include the application of vertical farming (hydroponics) which can ensure reduction in production losses due to extreme or unexpected weather occurrences (as crops are produced in controlled environments), and the practice of bring production and processing closer in rural areas using technologies such as Mobile Processing Units, Mobile Drying Units, Mobile Milling units, so as to limit losses during transit to processing factories.

Some examples of valorizing side streams that would otherwise lead to waste in the chain include the use of onion skin waste (which is a major industrial waste) for the production of biosugar,[155] and the use of onion bulb wastes as feedstock for biogas production (onion bulb wastes contains easily-degradable substrates has relatively high methane production potential).[156] Other possibilities under applying CE to valorize side streams include the use of tomato plant residue for producing textile and bio-based packaging.

5.3.2 Some local solutions exist

- Zero Energy Cool Chambers (ZECC) is a cost-effective storage facility for tomatoes which could be locally built. ZECC are "double brick wall structures, with cavities filled with sand and walls soaked with water. These chambers are easy to build with bricks, sand and bamboo and do not require any electricity or power to operate. Fruits and vegetables are placed in plastic crates and staked in the cool chambers. This practice can reduce temperature by 10 -15^{o}C and maintain high humidity of 95% that can increase the shelf life and retain the quality of horticultural produce" (Sahel, 2017). ZECC local storage facility also applies to onion preservation as well. It functions as a local cooling system device using sand, which provided moisture that kept onions continuously fresh over a long period of time. It was reported that Fanzar Farms in Yobe State Nigeria already successfully preserved over 200 bags of onions for about five months, using the ZECC local technology.[157]
- Packaging of tomatoes is still done in raffia baskets, that do not provide sufficient air and protection to the tomatoes especially during transport. Locally sourced solutions for packaging could be explored. According to CGIAR research, "a simple technological solution such as transporting tomatoes in plastic crates instead of woven baskets – reduces losses during transportation from 41 percent to 5 percent and delivers a monthly IRR of 34 percent over seven months". The study estimates that the crates would "deliver proportional reductions in emissions, i.e., 0.02 tCO2e per crate per year". Nigerian Stored Products Research Institute (NSPRI) is said to have locally developed reusable plastic crates (RPCs) which can be used to pack perishable food.[158]
- Kaduna State has established a tomato value addition aggregation packing house to assist local farmers in minimizing their postharvest losses. The packing house is a large storage facility where fresh fruits and vegetables can be collected, washed, sorted and stored in pre-coolers, prior to market.[159]
- Drying (Tomato and Pepper): new trends in solar drying system are being developed by the Nigerian Stored Products Research Institute (NSPRI) in order to provide solutions to the threat in food safety, food loss as well as farmers and processors quest for drying with minimal energy cost. The technologies include mobile solar tent dryers (made of polyurethane insulators, green house solar tent dryers and parabolic solar tent dryers.[160]
- ColdHubs: "A plug and play modular, solar-powered walk-in cold room, for 24/7 off-grid storage and preservation of perishable foods". It seeks to address the problem of post- harvest losses in fruits, vegetables and other perishable food. ColdHubs can be installed on major markets, collection points and farming areas, wherein fresh produce are placed in clean plastic crates and stacked inside the cold room. This initiative is said to extend the shelf life of perishable food from 2 days to about 21 days.[161]

5.3.3 Value addition through processing

- There is significant potential for local value addition in preserving fresh tomato and processing tomato into paste. Nigeria currently imports 300,000 tons of tomato paste. Gains in value added opportunities should first target the gap in local demand, before considering export markets. Current demand gap for fresh tomato fruits is estimated at about 2.3 million metric tons per annum while the country produces only about 1.1 million. There are several SMEs that are involved in taking good advantage of this potential for value addition in processing, but they require financial support. There have been setbacks in efforts to create local added value in tomato processing; for instance, in the past, the 1,200 metric ton capacity tomato processing facility established by Dangote Farms Ltd. shut down due to several institutional challenges and significant tomato production losses caused by the widespread pest infestation (*Tuta absloute*). Dangote produces a special variety of tomato at its farms that would yield around 60 tons per

hectare, six times the yield of the local tomato farmer. The factory is said to have resumed again in 2019, but at a significantly lower processing pace of 100 tons per day.

- Considering the millions of households, hotels, restaurants, pepper soup joints and others making use of onions everyday around the world, Nigeria stands to generate at least USD 420 million from exporting the crop if there is value addition. [162] Onions is a huge business with good turnover for serious farmers because, it is highly consumed around the world and the demand is rising every day. According to statistics, onions exporters earned USD 3.3 billion in 2015 and Nigeria was not among the 15 countries that benefitted largely from these export earnings[163] One key area for potential local value addition is in developing storage and processing facility for white onion powder and onion flakes production for local and international markets. SMEs such as Tays Foods Nigeria Limited, plans to invest in building a facility for this purpose. Also, already, Nigerian based companies (such as Unilever Nigeria Plc, AACE Foods and SPAR) and foreign companies (such as Bejo Zaden B.V. and Sotraco-Niger) are interested to become active as off-takers in the processing, packaging and exporting of white onion powder.[164]
- Local value addition can be generated in the processing of fresh chili pepper into chili powder. Other value-added possibilities include Industrial processing for use in topical creams meant for lessening pains, inflammations and itching, green chili extract used as bioinsecticides.

5.3.4 Possibility of applying digital smart tools

As noted in section 3.5.2, there is increasing use of digital tools such as Blockchain, Artificial Intelligence, Drones, satellite imaging, digital sensors, and advanced data analytics in Nigeria. Companies like BeatDrone based in Lagos support farmers with soil analysis and improvement using drones; “Chowberry” app was developed to address the issue of food waste by consumers; “Kitovu” an agricultural-focused technology company uses data to eliminate agricultural supply chain inefficiencies; Cellulant developed “Agrikore” a blockchain based smart-contracting, payment, and marketplace system which is designed to ensure that stakeholders in agricultural value chains can do business transparently, “Hello Tractor” app links the farming community to tractor hiring services, and Farmcrowdy: Known as Nigeria’s First Digital Agriculture Platform that empowers rural farmers by providing them with improved seeds, farm inputs, training on modern farming techniques and provides a market for the sale of their farm produce. These examples show that the agri-tech sector in Nigeria is growing and shows potential to develop and apply digital smart tools for curbing losses and inefficiencies at various parts of the value chain from input to market.

5.3.5 Possibility of engaging youth in elaborating food loss solutions

One crucial threat mentioned by stakeholders in these three VCs is the ageing population of farmers and the migration of Nigerian youth from rural areas to the cities. This leaves a serious challenge to sustain vegetable cultivation in rural areas. In Nigeria, nearly 25 percent of the general population are unemployed, 20 percent are underemployed and over 50 percent of youth aged 15 – 35 years are without work.[165] In Nigeria, the proportion of youth aged 18–24 in the population is significantly higher than the global average, reaching almost 70 percent. While this population can be viewed as a great asset with vast potential, Nigerian youths are plagued by scant opportunities for their personal and professional development. As mentioned in 4.1.2, some government programs are now targeting youth in the agricultural sector. To further involve Nigerian youths in tackling food loss, RVO and CBI could partner with the Orange Corners initiative in Nigeria (initiated by the Netherlands Embassy) to organize a National Hackathon on solutions for food losses in the selected VCs.

5.3.6 Possibility to leverage existing associations to address food loss

As noted in section 3.3.1, several associations exist at national and local level that support tomato, onion and chili farmers in organizing, advocating/lobbying and capacity development. e.g., Tomato Growers Association of Nigeria (TOGAN), Tomato and Orchard Producers Association of Nigeria (TOPAN) and the National Tomato Growers, Processors and Marketers Association of Nigeria. National Pepper Producers, Processors and Marketers Association of Nigeria, and Federation of Agricultural Commodity Association (FACAN). Other important associations in the value chain are Mile 12 Traders association and National Association of Road Transport Owners (NARTO), representing traders at Mile 12 vegetable market and transporters respectively. These associations have clear governance structures including management roles and responsibilities. They are recognized by the government and are active in influencing government initiatives in the sector. If supported and trained, they could be instrumental to addressing food loss in the three VCs.

5.3.7 Potential for cool chain transport and railway as alternative to road

- The potential for continuous use of rail transport in moving tomatoes to markets (e.g., Kano to Lagos) is already being explored by the Nigerian Railway Corporation (NRC). This can add value by reducing the challenges faced in the tomato VC from poorly serviced vehicles, bad roads and multiple state taxation as the trucks move through several states to distant markets. In 2017, Nigeria freighted 16.3 metric tons of tomato (about 650 plastic crates weighing 25kg per crate) from Kano to Lagos after 58 years of lack of rail transport use. Nevertheless, rail transport still has teething problems, for instance, the freight mentioned earlier had a 7-hour delay prior to departing due technical issues. Sector experts note that the transportation of tomatoes by rail could reduce food loss caused by road transit by 40 percent.[166]
- Together with Naija Pride, APM Terminal is working to provide modern cold chain transportation alternatives for farmers in the agricultural centers of northern Nigeria to bring fresh produce intact and unspoiled to market centers in Lagos. APM Terminal intends to use cold chain transportation to demonstrate ways in which efficient transportation means can be used to reduce post-harvest losses and extend the shelf life of fresh produce to local consumption and export.
- In 2015, several members of the Global Cold Chain Alliance (GAIN) visited with the Global Alliance for Improved Nutrition (GAIN) Postharvest Loss Alliance for Nutrition Project (PLAN) project to brainstorm opportunities for cold chain and supply chain development in Nigeria.[167] Recently (February 2020), the Organization for Technology Advancement of Cold Chain in West Africa (OTACCWA) joined the Global Cold Chain Alliance with the intention of promoting and facilitating the development of the cold chain system in Nigeria and West Africa.[168]

5.3.8 Anchor Borrowers Programme accessible

CBN's Anchor Borrower's Programme (ABP) is aimed at creating a link between off-taker companies involved processing and smallholder producers of some agricultural commodities. Tomato is one of the targeted commodities. Onions and Chili are not mentioned, but there is possibility of extending the Anchor Borrower's Scheme to cover these two VCs as well, as CBN indicated that from time to time, they will expand the list of commodities targeted. Already, some Yellow Chili farmers have been shortlisted to benefit from the ABP. [169]

5.3.9 Possibility to leverage existing waste policies to address food loss

As noted in section 3.5.5, Nigeria recently approved a new national Solid waste management Policy which takes into account the wastes generated from agricultural production but does not address food loss. A separate Agricultural Waste Management policy is still in draft since 2012, which was developed together with UNEP. The policy is yet to be adopted or developed into a comprehensive legislation and plan to address agricultural wastages in Nigeria. This creates an opportunity for RVO to engage with the NESREA to ensure that this policy is (finalized and is) robust enough to address agricultural post-harvest losses in value chains.

5.3.10 Already existing projects and local initiatives focusing on food loss

As indicated in section 2.5, there are already several existing programmes and projects targeting food loss in the three value chains. Section 5.1.1 highlights projects being implemented by Dutch companies. Section 5.1.3 highlights locally developed initiatives applicable to the three value chains. Some of these could potentially be linked to the eventual RVO programmes or projects on food loss. RVO could for instance support the expansion or scale-up of some of the promising existing projects (see section 5.2).

5.2 Interventions

In this section, we highlight some quick wins, cluster and generic interventions. As mentioned in Chapter 2, food loss is still a big challenge for Nigeria due to various reasons. The current situation in Nigeria regarding food losses in the three VCs has gone on for too long without an effective strategy and solution. While the challenges are well known, there is no holistic strategy to tackle this issue. There are some relevant projects and programs by chain supporters and influencers, with activities on tackling food loss, but these are not part of any well-coordinated holistic strategy. Sector experts interviewed concur that, any proposed intervention or solution by RVO, CBI and other VC actors should take a *holistic approach.* No meaningful results would be achieved on the food loss issue, without an intervention with a long-term time horizon; engagement and partnership with the Nigerian government, investments at all stages of the value chains, and build mutual trust between actors and cooperation of all stakeholders.

In addition to the quick wins and generic interventions, we recommend that RVO and CBI apply a cluster approach to solve the key challenges that result in significant food loss in the three value chains.[170] Whereby, multi-stakeholder clusters (i.e., a combination of at least companies, government agencies, NGOs, Institutes) are developed between Dutch and Nigerian stakeholders around topics that could address food loss. Increasingly, the cluster approach is used by most countries to organize a market-led economic development strategy by initiating dialogue between the various actors in their relevant systems of innovation. According to the OECD,[171] the cluster approach is used by countries like the Netherlands as a market-led business development strategy to bring together actors and organisations and to foster knowledge exchange and transfer. It "accounts better for the changed nature of competition and market-based innovation systems and the main sources of competitive advantage. It captures important linkages in terms of technology, skills, information, marketing and customer needs that cut across firms and industries. Such linkages and interdependencies are fundamental to the direction and pace of innovation".
There is already a Seed Cluster Programme involving Dutch and Nigerian partners, being facilitated by the NABC. Similar clusters could be developed around key issues for addressing food loss and waste in tomato, onion and chili value chains. See figure below illustrating the recommended clusters and associated interventions.

5.2.1 Quick wins

As noted earlier in Chapter 2, several projects and initiatives are currently ongoing to address food loss from agriculture in Nigeria, many of which already include one or all of the three VCs. It is therefore recommended that as quick wins, RVO and CBI intervention could support the expansion or scale-up of promising existing projects and local initiatives and projects in the three value chains. We recommend the following projects to be expanded or scaled-up or joined as part of RVO and CBI intervention on food loss in Nigeria:

Recommendations	Possible Partners
A. **Join EU/GIZ NICOP initiative, extend its duration and expand the focus to cover onions VC:** RVO could discuss possibilities with the EU, German BMZ and GIZ, to join the NICOP project and extend its duration beyond 2022. NICOP already focuses on *Tomato and Pepper, Ginger, Leather and Garments with key focal states Abia, Kano, Kaduna, Lagos, Ogun, Oyo, Plateau.* RVO and CBI could propose the inclusion of Onions VC and onion producing state such as Sokoto.	EU Delegation in Nigeria, BMZ, GIZ /SEDIN, RVO, NL Consulate General in Lagos, Nigeria Ministry of Agriculture and Rural Development (FMARD).
B. **Partner with IFC TechEmerge Programme[172] to support innovations on Temperature -Controlled Logistics in Nigeria.** In collaboration with Kobo360—an e-logistics platform operating across Africa that connects truckers to customers—TechEmerge will match innovators across the world (including locally-based innovators with homegrown solutions) with leading companies in Nigeria to pilot sustainable cooling solutions that reduce losses in supply chains, strengthen access to TCL-dependent products and markets, and build commercial partnerships. They will provide access to a pool of up to USD 1 million in funding to support pilot projects. RVO could discuss possibilities with IFC TechEmerge team to join this initiative.[173]	RVO (DGGF), IFC (TechEmerge), Kobo360.
C. **Support the scale-up (or further development) of existing local Initiatives:** RVO could partner with NSPRI to develop some of the low-cost locally made technologies which it claims to have developed. Some of their initiatives include evaporative coolant system for fruits and vegetables, stackable crates for tomatoes, and cane baskets for keeping vegetables fresh.[174] Others are ventilated fruit shed, solar tray dryer, multi-crop dryer, Hybrid dryer and polythene tent dryer. RVO could encourage Dutch SMEs to partner with local firms in scaling up some of the existing locally made solutions such as: Solar-powered walk-in cold rooms, Mobile solar drying tent, Construction of aggregation and packing houses, and Zero Energy Cooling Chambers	RVO, NL Consulate General in Lagos, NSPRI, Nigeria Ministry of Agriculture and Rural Development (FMARD).

Recommendations	Possible Partners
D. In Subsequent rounds of the SDGP subsidy program, RVO could consider encouraging projects such as, *PROTOMATO: Reduction of post-harvest losses of tomato in Nigeria* which was not successful in its SDGP application in 2018. Dutch company Agrofair and partners applied for RVO's SDGP Facility in 2018 but was rejected. The project aimed to contribute to improvement of the economic and environmental performance of tomato value chains in Nigeria and of the profitability for farmers and retailers, focusing on reduction of post-harvest losses as entry point, improving logistics and transport, by (1) introducing and normalizing plastic returnable crates on a large scale, and (2) introducing a cold chain from farm to market. **PROTOMATO Partners could be encouraged to re-apply with an expanded focus (i.e., to cover tomato, onion and chili value chains in Nigeria).**	Agrofair Benelux B.V. , Alyx Limited, Nigeria Investment Promotion Commission (NIPC), ENCLUDE B.V., Trading as Palladium Europe, and Centre for Agricultural Research and Extension Services (CARES) - Federal University Dutse (FUD).
E. **Encourage the replication of successfully funded RVO Projects (particularly FDOV and PSD Toolkit) by Dutch companies/NGOs, which are ongoing in other countries or other sectors (but are applicable to addressing food loss in tomato, onion and chili VCs in Nigeria),** such as: i. For developing the vegetable seed industry in Nigeria and providing farmers with access to practical knowledge, skills and information about vegetable production and marketing, see replicable examples: Seeds of Expertise for the Vegetable Industry of Africa (SEVIA), in Tanzania and SEED2FEED, in Ethiopia. ii. For reducing food loss by creating an integrated supply chain, including cold chain infrastructure (i.e., setting up polyhouses, a track and trace system and warehouses), see replicable example: Reducing Food Wastage in the supply chain of fruits and vegetables, in India. iii. For providing access to financial/credit services to rural farmers, see replicable example: Access to rural based financial services, in Ethiopia. The project aims to upgrade an existing and verified mobile banking system and platform technology to render financial/credit services to smallholder farmers in 4 regions in Ethiopia, using existing relations with MFIs. iv. For contributing to women entrepreneurship by creating a secure year-round market (and long-term contracts) for women as well as capacity development for business planning for women cooperatives (in tomato, onion, and chili VCs, ee replicable example: She Sells Shea, in Mali and Burkina Faso.[175] v. For stimulating circular economy initiatives and partnerships (including concrete opportunities for cooperation and knowledge transfer between the Dutch and Nigerian on CE) to address food loss in the three value chains, example of useful or replicable projects include: **Scoping Study waste management /Circular Economy, in Nigeria**,[176] and **Biomass Valorisation Business Centre in Rwanda**,[177]	I. RVO, East West International, Rijk Zwaan Zaadteelt en Zaadhandel BV, Rijk Zwaan Afrisem, Stichting Dienst Landbouwkundig Onderzoek WUR Applied Plant Research; and RVO, Larive International B.V., Broekman Logistics., Rijk Zwaan Zaadteelt en Zaadhandel B.V., Nederlandse Organisatie voor toegepast-natuurwetenschappelij II. RVO, Stichting Dienst Landbouwkundig Onderzoek, Rhea Composites, Koppert B.V., Incotec Group B.V. III. RVO and Enclude B.V IV. RVO and Stichting Interkerkelijke Organisatie voor Ontwikkelingssamenwerking, ICCO V. RVO and Stichting Holland Circular Hotspot; and RVO and Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO

5.2.2 Generic Interventions

Generic intervention to curb food loss and waste from food value chains in Nigeria should include action on the following:

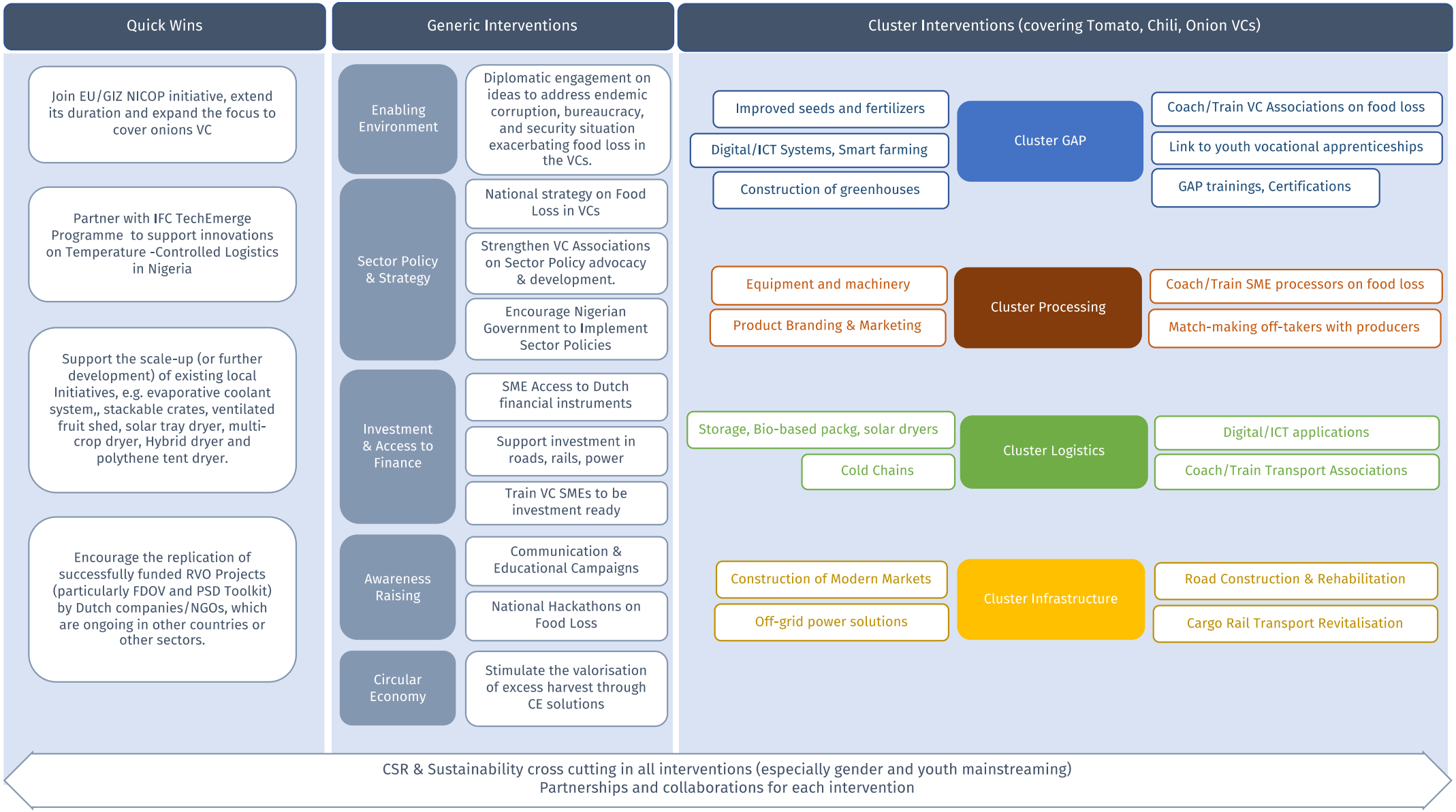
Recommendations	Possible Partners
A. Engage with the Nigerian Government to address some of the challenging political economy issues mentioned in *section 3.5.5*, to ensure a better enabling environment for the value chains to operate in. i. Support the Nigerian Government to develop a central strategy on food loss from agri-food value chains. The Agricultural Waste Management Policy which is currently in draft provides an opportunity to elaborate on a policy and strategy to address food loss. As part of the activities under the bilateral relations between the Netherlands and Nigeria on agribusiness,[178] the Netherlands Embassy (and Consulate General) in Nigeria could offer to support the Nigerian government in developing a clear strategic framework that covers food loss from agricultural value chains (including the three VCs under this study). Such a central strategy could include stakeholder actions, incentives and policy to address food loss from agricultural value chains. ii. Provide financial and technical support to strengthen tomato, onion and chili associations by providing effective training and coaching on dealing with on-farm and post-harvest losses, literacy skills on proper financial management, skills for defining a strong business model, crop planning as well as marketing (particularly in anticipation of seasonal glut), CSR, and skill set to market their value chains to off-takers and transparency (including the development of functional public websites). iii. Encourage sensible reforms in Nigeria's public security sector by leveraging the pledge made by the Netherlands government to provide humanitarian assistance to Nigeria mitigate impact of insecurity and displacement (particularly for girls and women). iv. Encourage FMARD through diplomatic channels, to fully implement the Tomato sector policy and to develop policy reforms for other value chains such as Onions and Chili.	RVO, CBI, NL Ministry of Foreign Affairs, the Netherlands Embassy in Abuja and the Netherlands Consulate General in Lagos, NESREA (and the Ministry of Environment), National Food Security Council, and FMARD.
B. **Financial support to improve roads, energy infrastructure as well as the machinery used in the VCs:** The lack of sustained investment for better access roads and railway, energy as well as modern production and processing equipment is seen as one of the main bottlenecks in the three VCs that lead to the increase in food losses. (i.e., poor storage and processing facilities, bad roads, lack of cold chains, and lack of electricity for chilling and processing all contribute to losses across the value chains). RVO could partner with the Nigerian government, Dutch and local banks (such as BoA) to ensure that financial support is provided to market- based models for low-cost storage, preservation, and processing technologies that can create accessible solutions for food loss; as well as the expansion of Nigerian SME operations that develop technology, infrastructure, and other agro-processing solutions aimed at reducing food loss and directly creating off-farm jobs. Investments could also be made to build roads, railways and cold chain to connect farmers (on the VC trade region and routes) with main markets. Regarding roads, the Nigerian government is aiming to construct a so-called "*Golden (Economic) Triangle Super Highway*" that will link major cities across the country, adding around 5,000km to the current road network.[179] The government could be encouraged to make institutional arrangements (in form of incentives) and reforms to facilitate access of the private sector investment to production and processing in the VCs (e.g., extending the Anchor Borrower's Scheme to cover Onions and Chili VCs. Already tomato is included in the list). C. **Access to finance and (particularly) financial capacity development for SMEs in tomato, onion and chili value chains:** SMEs (particularly women-	RVO (DTIF, D2B, FDOV), FMO, Nigerian Ministry of Power, Works and Housing, Nigeria Rural Electrification Agency, Nigerian Railway Corporation, Central Bank of Nigeria (CBN), Access Bank, and Bank of Agriculture (BoA)

Recommendations	Possible Partners
owned and women led) in the three value chains are still not financially sound. Most of them still require financial support but are ill-equipped with business and financial knowledge and tools to attract investment, particularly for processing and export. RVO could provide financial and business management (FiBuMa) training to a selection of the SMEs in each of the VCs, to ensure that they are investment ready. The FiBuMa training could include organisational and financial aspects such as business review, elaboration/improvement of the business plan, elaboration of budget forecasts, realization of financial and organisational management tools, financing policy of the organisation, cash flow, stock, analysis/ monitoring of risks, etc. Already in 2014 Access Bank Nigeria launched the "W Initiative"[180] which aims to offer special credit line, (financial) training and business support specifically to women in Nigeria. Dutch Entrepreneurial Bank FMO contributed half of the USD 60 million special credit line.[181] Such initiatives could be scaled up or replicated targeting SMEs (particularly women-owned and led) in these three value chains.	
D. **Stimulate the Circular Economy approach to address food losses in Nigerian food value chains (with accent on the selected three VCs – tomato, onions and Chilli).** i. Possibilities include, supporting the activities and projects of the existing CE platforms in Nigeria (i.e; Nigeria Circular Economy Working Group (NCEWG), African Circular Economy Alliance (ACEA), including the development of a Circular Economy Roadmap for Nigeria. ii. Explore the possibility of setting up a food loss or Biomass valorization Center in Nigeria.	RVO (SDGP, FDOV, PSD Toolkit), Holland Circular Hotspot, TNO, Africa Circular Economy Network Nigeria Chapter, Nigeria Circular Economy Working Group (NCEWG), Nigerian Stored Products Research Institute (NSPRI), Oxfam Novib.
E. **Communication and education campaigns targeted to reduce food loss (and wastage):** Nigeria has a poor record regarding waste management. It is a common feature in the country's rural and urban areas to see huge wastes generated by human and industrial activities left without disposal and treatment. Throughout the years, waste production, collection and disposal in Nigeria has been a greater issue of concern. In Nigeria, significant amounts of wastes are produced from different waste streams (including losses at each part of the food value chain). Waste is often dumped by roadsides, accessible open pits, rivers, and gutters. There is need for intensive and consistent communication and educational campaigns targeting the behavior of Nigerians on the need to reduce food loss (and wastages) associated with these three value chains. Luckily, these VCs are heavily consumed by most Nigerians, and farmers easily recognize that food losses also affect their bottom-line. This intervention should particularly target value chain actors and consumers, with consistent public service messages, tips and practices on how to apply the 3Rs from farm to fork. RVO can partner with Farm Radio International to expand on their current food loss communication programme in the tomato sector, to cover onion and chili VCs as well.	RVO (PSD Toolkit), Farm Radio International (Nigeria), orange Corners (Ministry of Foreign Affairs, NL Consulate General in Lagos)
F. **Organize a National Hackathon on solutions for food losses in the selected VCs.** To further involve Nigerian youths in tackling food loss, RVO and CBI could partner with the Orange Corners initiative in Nigeria (initiated by the Netherlands Embassy) to organize a National Hackathon on solutions for food losses in the selected VCs. This is a common way to include the youths in Nigeria towards solving big challenges. Hackathons are not new to Nigeria, several major Hackathons are being organized on topics such as Justice, Healthcare, Agriculture, Citizen Safety, etc. In line with this recommendation, there is already a Circular Economy Hackathon being organized for February 2021 by the NL Consulate General in Lagos and the Nigeria Climate Innovation Center (NCIC). The Hackathon will feature participating companies and their challenges, such as Heineken	RVO, orange Corners (Ministry of Foreign Affairs, NL Consulate General in Lagos) and the Nigeria Climate Innovation Center (NCIC), Holland Circular Hotspot, Africa Circular Economy Network Nigeria Chapter, Nigerian Stored Products Research Institute

Recommendations	Possible Partners
(*towards a circular PET economy in the country*), Farmforte (Amongst others, it seeks solutions to *addressing supply chain waste: Spoilage of fresh fruit in transit*). Other participating companies are Skretting Nigeria, and New Generation Nutrition.[182]	

5.2.3 Cluster-based interventions

We recommend that RVO and CBI consider developing clusters around four broad topics: GAP, Processing, Logistics and Infrastructure as indicated in the figure below.



I. Cluster on GAP

Recommendations	Possible Partners
• Support significant productivity in the three value chains and an increase in provision of improved seeds and fertilizers as well as transfer of best practice information to smallholder tomato, chili and onion farmers. • Provide training for farmers on GAP practices and Pesticide control measures to prevent seed contamination and quality degradation. Support farmers to obtain Global GAP certifications and to comply with other relevant standards. Already RVO (via PSD Toolkit) financed the training of 25 trainers in vegetable cultivation best practices as part of the impact cluster seed4change in Kano state.[183] Such funding can be made available for this recommended cluster on GAP to support smallholder farmers and professionals in the tomato, onion and chili value chains.	*Dutch Partners*: RVO, CBI, Bejo Zaden, East West Seeds, Rijkzwaan, Enza Zaden, Koppert, Van der Knaap, WUR. *Nigerian Partners*: National Agricultural Seed Council (NASC), Afri Agri Products Ltd., Bayero University Kano, IITA, o Standards Organisation of Nigeria (SON), National Agric Extension Research and Liaison Services
• Support smallholder tomato farmers with the technology and materials for greenhouses. • Explore the possibility of working with Dizengoff Nigeria's Farmer's Kit (with Family Drip System (FDS), Farmer's Greenhouse and agro-inputs such as Seeds, Fertilizers and Agro-Chemicals).	*Dutch Partners*: RVO, Bejo Zaden, East West Seeds, Rijkzwaan, Enza Zaden, Koppert, Van der Knaap, WUR. *Nigerian Partners*: Dizengoff
• Introduce Digital/ICT tools for Smart farming, etc. and to curb production inefficiencies and losses in the three VCs	*Dutch Partners*: RVO, WUR, VanderSat, Eaglesensing, Bioscope, Mythronics, Geerbox, *Nigerian Partners*: BeatDrone, Kitovu, Chowberry, Agrikore, Farmcrowdy, Office for ICT, Innovation and Entrepreneurship in Nigeria (OIIE).
• Coach/Train associations on credit-worthy agricultural business plans development for the three value chains. • Coach/Train associations regarding practical on-farm solutions to reduce losses in the three value chains	Dutch Partners: RVO, WUR, Agrofair, Oxfam NOVIB, 2Scale Partners, Nigerian Partners: SNV, Synergos and Technoserve
Technical and vocational training for youth on: • Practical on-farm solutions to reduce losses in the three value chains, • Setting up of agri-business incubators for young and female entrepreneurs, and • Linking GAP and extension training activities with youth vocational apprenticeships/internships. • To ensure greater inclusion of youth in tackling food loss and waste, RVO could work with educational institutions and the Ministry of Education in Nigeria to create a link with youth vocational apprenticeships in the country, particularly on the three value chains under this study. • The Netherlands Ministry of Foreign Affairs could through YEP Agrofood, offer an opportunity for Young Dutch Experts to be involved in contributing to tackle food loss in Nigeria	Dutch Partners: RVO, WUR, Netherlands Ministry of Foreign Affairs – IGG, HDPO (through YEP Agrofood) Nigerian Partners: Ministry of Education, the Federal University with Horticulture Dept. (FUNAAB); the private Landmark University of Agriculture; and the Federal College of Horticulture at Dadin Kowa (at national level); Bayero University; Kano State University of Science and Technology at Wudil; the Federal College of Agric. Produce Technology; and Audu Bako College Agriculture at Dambatta (in Kano State); Ahmadu Bello University and Division of Agricultural Colleges; the Federal College of Forestry Mechanization; and the Federal Cooperative College (Kaduna State), Federal University of Technology Owerri (Agric Extension).

II. Cluster on Processing

Recommendations	Possible Partners
• The cluster program should aim to work together with partners in Nigeria to ensure that processing equipment and machinery (instrumental to	*Dutch Partners*: RVO (DTIF, FDOV), Duijndam machines, H&G,

curbing food loss) are developed/ fabricated in the country and provided at low cost to SMEs in the VCs. • This cluster could also explore the possibility of establishing a program whereby Dutch companies specialized in agricultural and horticultural machineries can export fairly used equipment and machinery to SMEs in Nigeria, and the know-how to operate and service them. • As processing equipment and machinery are quite expensive, most SMEs in Nigeria would be unable to afford the investment necessary for procuring them.[184] The cluster program could also focus on ways to provide access to finance for SMEs in the three VCs to hire equipment and machinery when available in the country (the National Centre for Agricultural Mechanization (NCAM) has a hiring service for agricultural equipment and machinery which could be expanded).	*Nigerian Partners*: AMEFAN (Agricultural Machineries & Equipment Fabricators Association of Nigeria), NCAM, Federal Ministry of Agriculture and Rural Development (FMARD), Hello Tractor.

III. Cluster on Logistics

Recommendations	**Possible Partners**
• Improve infrastructure and coordinated transportation (logistics) including cold chain facilities • One of the main challenges in these value chains is the lack of proper coordination, transparency and traceability of actors and products at each phase of the chain. RVO and CBI could work with partners to introduce digital ICT applications to improve actor coordination and communication, as well as product traceability and chain transparency. For instance, sensors can be placed directly on trucks transporting tomatoes, chillies or onions which can provide remote readings of a specific cargo's temperature, humidity, or movement to ensure fewer spoils in transit. Technology could also be deployed to facilitate shorter value chains whereby farmers easily have access to consumers and easy rural-urban linkages.	*Dutch Partners*: RVO (Omnivent, Platform Logistics, WUR on logistics expertise, APM Terminals, TNO, Dinalog, Conekt, Jan de Rijk Logistics, ASML, DAF Trucks, Fokker Services, Gordian Logistic Experts, IBM, Océ Technologies *Nigerian Partners*: Redstar Agro Logistics
• Several studies have explored possible technological solutions including temperature-controlled storage (such as evaporative coolers) and energy efficient refrigeration[185] coupled with adequate storage, including hermetic bags (onions),[186] edible coatings reusable plastic crates (tomato), as well as improved storage during transport, such as using plastic crates during transport (tomato and Chilli) and vented trucks for fresh food transport,[187] and smart or biobased packaging.[188] In addition, Tomato or vegetable that is unsold at the end of the market day could simply be solar dried and converted to dried tomato or dried vegetables, as an alternative product line.[189] • RVO through Drive and DGGF can encourage more Dutch entrepreneurs with innovative technical solutions to address food loss-related challenges linked to storage, transport and logistics	*Dutch Partners*: Liquidseal, Coolfinity, RVO (Drive, DGGF) *Nigerian Partners*: Organization for Technological Advancement of Cold Chain in West Africa (OTACCWA), Federal Ministry of Agriculture and Rural Development (FMARD), Office for ICT, Innovation and Entrepreneurship (OIIE), Beat Drone, Cold Hubs Limited, Nigerian Stored Products Research Institute (NSPRI), Tays Nigeria Limited.
• RVO could provide coaching and training to associations of transporters and market traders in each value chain on the topic of VC food loss and waste.	Dutch Partners: RVO, WUR, Agrofair, Oxfam NOVIB, 2Scale Partners, Nigerian Partners: SNV, Synergos and Technoserve

IV. Cluster on Infrastructure

Recommendations	Possible Partners
• This cluster could focus on solutions for road construction and rehabilitation. As noted earlier in section 5.2.2, the Nigerian government is aiming to construct a so-called "*Golden (Economic) Triangle Superhighway*" that will link major cities across the country, adding around 5,000km to the current road network. • Cargo Rail Revitalization: Sector experts note that the transportation of tomatoes by rail could reduce food loss caused by road transit by 40 percent. The potential for continuous use of rail transport in moving tomatoes to markets (e.g., Kano to Lagos) is already being explored by the Nigerian Railway Corporation (NRC). This can add value by reducing the challenges faced in the tomato VC from poorly serviced vehicles, bad roads and multiple state taxation as the trucks move through several states to distant markets. Nevertheless, the railway system (infrastructure, skills of staff, etc.) needs revitalization. This cluster could focus on solutions to improve cargo rail transport for fruit and vegetables. • Off Grid Power Solutions: Almost half of Nigeria's population have limited or no access to grid electricity. A significant portion of Nigeria's economy is powered by small-scale generators (10–15 GW). According to Nigeria's Rural Electrification Agency (REA), every year, businesses and households spend almost USD 14 billion on inefficient power generation. Developing complementary off-grid solutions in Nigeria will create about USD 9.2Billion/year market opportunity for mini-grids and solar home systems. This would provide smallholder farmers and SMEs with huge savings. [190] REA has developed a National Off-Grid Electrification Strategy for Nigeria and partners such as GIZ, USAID are involved in supporting the implementation of this strategy. RVO and Dutch partners could join this initiative. • Construction/ Modernization of Markets: The UK (DfiD) appears to show interest in supporting the Lagos State Government in building an ultra-modern market at Mile 12. This could be an opportunity for RVO to be involved in (Lagos alone has around 33 markets, most of them with similar situation and in need of re-building).	Dutch partners: RVO (D2B) RVO (DTIF, D2B, FDOV), FMO, NXT Grid and Solarcreed Nigerian Partners: Nigerian Ministry of Power, Works and Housing, Nigerian Railway Corporation, Lagos State Government, CBN, Access Bank, and BoA, Solar Nigeria, Lighting Nigeria,

5.3 Risk Assessment

The risk assessment is presented based on the following risk assessment matrix:

- Likelihood of materializing: 5= almost certain; 4=likely; 3=possible; 2 =unlikely; 1=rare
- Impact on project: 5=severe; 4=major; 3=moderate; 2=minor; 1 negligible.

Risk or Critical Assumption	Possible impact on Proposed CBI intervention	L	I	Mitigation Strategy
Security threat especially in the Northern part of Nigeria.	There will be significant disruption of the project activities should there be an active security threat or incident in this area. Normally, security incidents paralyze economic activity, and this affects all parts of the chain.	4	4	• Closely monitor events in the Northern part of Nigeria. The Netherlands Embassy in Abuja is a good source for latest information in the region. • Create a project security risk tracking tool and update regularly based on information from credible sources in the country (embassy, Dutch NGOs based in Nigeria, etc.). This can be done by the project lead based in Nigeria. • Involve local leaders in project design and execution to ensure local ownership and protection in case of crisis.
Poor enabling environment and lack of cooperation from government officials in Nigeria can create significant bottlenecks	Without the government's involvement (both local, state and national), the project would experience significant bottlenecks and may never succeed.	4	4	• At the outset of the project design, involve government officials at both local, state and national levels. • Invite government officials to the validation sessions and maintain close contact with them throughout the process.
Lack of cooperation with other international development partners already working on tomato, onion and chili value chains in Nigeria	Without the cooperation of international development partners in Nigeria who already are working in these value chains, the proposed intervention will be challenging for RVO and CBI to realize alone. Exchange of experiences, lessons learned, and risk sharing is crucial.	3	3	• At the outset of the project design, explore synergies with international development partners such as EU/GIZ and British Deputy High Commission, where each partner plays distinct role(s) towards a shared goal. • Invite EU/GIZ and British Deputy High Commission to the validation sessions and maintain close contact with them throughout the process.
Language and poor education as barriers. Although most people speak English in Nigeria, the project may encounter SMEs, Associations and other local chain stakeholders who only speak Hausa or other local dialects.	For the success of any intervention by RVO and CBI in Nigeria, it is important that the issue of language barrier is addressed. SMEs and associations may find it challenging to communicate in English. Also, it is important to realize that most tomato, onion and Chilli chain actors and supporters in the Northern part of Nigeria are not educated with high qualifications. Trainings and coaching sessions might be hindered.	3	2	• Training and coaching sessions and materials need to be adapted to the local languages and educational teaching methods should include visual aids and illustrations. • Hire trainers and coaches that can conduct work in the local languages (particularly Hausa). • Ensure that the project lead is multilingual, is based in Nigeria and can speak Hausa. • Always make arrangement to utilize good local translators if no native speakers are available.
Reputational damage from Corruption (Financial misconduct) and safeguarding (sexual misconduct) incidents of project partners, beneficiaries and other stakeholders. Potential of corruption cases of government officials or associations who are asking for payment of doing business, lowering	The reputation and credibility of RVO and CBI and the proposed project could be impacted if project partners, beneficiaries and other stakeholders are involved in corruption and/or safeguarding incidents. The risk is higher in the Northern part of Nigeria.	4	4	Request partners for procedures for preventing, deterring, detecting and responding to misconduct case. In addition, establish clear guidelines for reporting of cases to RVO and CBI. • Make transparency and corruption in explicit in MoUs • Involve the government and associations from the start that the project should benefit all members • Ask for advice from the Dutch embassy on how to support sector development and involvement of the public sector

Risk or Critical Assumption	Possible impact on Proposed CBI intervention	L	I	Mitigation Strategy
taxes or for (not) providing particular services				
SMEs involved in the project are untrustworthy. There is often a gap between what is agreed and what is delivered.	Although there is corruption in the country, it is expected that Nigerian SMEs involved in the proposed project are trustworthy and keep up to agreements. If these important aspects are not consistently established, the project will not thrive.	4	4	• Consistent monitoring and evaluation to be done. • Utilize the project lead based in Nigeria to establish, strengthen and maintain relationships between SMEs and EU companies. • Very strict selection criteria including ability to set up transparent supply chains, investments in management systems, staff •
Reputational damage from CSR risks of project partners, beneficiaries and other stakeholders: particularly child labor, poor wages, gender discrimination and inequality.	Producers and SMEs that are part of the project could still engage in child labor, poor wages, gender discrimination and inequality. This could affect the credibility of the project.	3	3	• As part of the project, set up a traceability system to track and document quality details at farm level, farmer buying criteria, etc. • As part of the project, ensure that producers and SMEs obtain fair trade certifications. • Conduct CSR/ ESG training or coaching for ginger SMEs.
Risk of COVID-19 prolonged restrictions.	Although long-term impacts of COVID-19 are unknown for the spices sector, it is anticipated that the lockdowns would restrict movements, and transportation, which could affect supply and price. Furthermore, producers and associations benefiting from the project are likely to be vulnerable due to the fact that most of their work are done manually.	4	3	• Conduct all training, coaching, and workshops virtually • Hire a local coordinating consultant (with expertise on business coaching and institutional capacity building) • Encourage project partners, beneficiaries and other stakeholders to follow national public health guidelines at all times. • SMEs should be encouraged to ensure that at all times, there is availability of personal protective equipment (PPE) for farmers and processing staff and that enforcement of PPE use, hand washing, and physical distance are practiced.

Annex 1 List of Organisations Interviewed

Participating organisations in online or written interviews, include:

- NL Consulate General Lagos
- Federal Ministry of Agriculture and Rural Development (FMARD)
- NEPC
- AgroFair
- Bank of Agriculture
- Easy Sauces
- Dangote Tomato
- Tomato Jos
- Standards Organisation of Nigeria
- OPAN
- FACAN
- Synergos
- GIZ
- TOPAN
- Oxfam
- National Horticulture Research Institute
- Technoserve
- Rijkszwaan
- East West Seed
- 2Scale
- HCH
- Coolfinity
- WUR
- IDH
- EUD
- NABC

Annex 2 Summary Survey Results and Key Points Validation Session

Validation workshop Food Loss in Nigeria (Tomato, Onions, Chili Value Chains)

Date: 26 November 2020 10:00-11:30

List of participating organisations:

- Ministry of Foreign Affairs: 2 Participants
- RVO: 3 participants
- NL Consulate General Lagos: 2
- Federal Ministry of Agriculture and Rural Development (FMARD): 1
- NEPC: 1
- AgroFair: 1
- Bank of Agriculture: 2
- Easy Sauces: 1
- Dangote Tomato: 2
- Tomato Jos: 1
- Standards Organisation of Nigeria: 1
- OPAN: 1
- FACAN: 1
- Synergos: 1
- SureChain: 3
- GIZ: 1
- TOPAN: 1
- Oxfam: 1
- National Horticulture Research Institute: 2
- Technoserve: 1
- Rijkszwaan: 1
- East West Seed: 1
- 2Scale: 1
- HCH
- Coolfinity
- WUR
- IDH
- EUD
- NABC

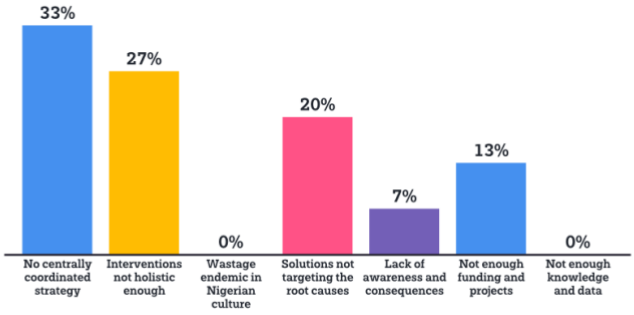
Summary of survey responses

Rijksdienst voor Ondernemend Nederland

Go to **www.menti.com** and use the code **21 13 88 2**

Why is food loss in tomato, onion and chili value chains still a critical issue in Nigeria?

SURECHAIN

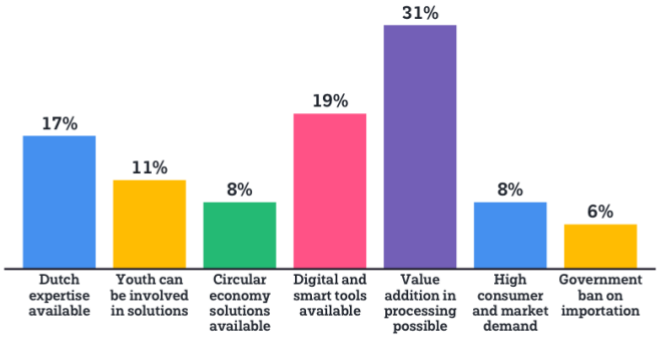


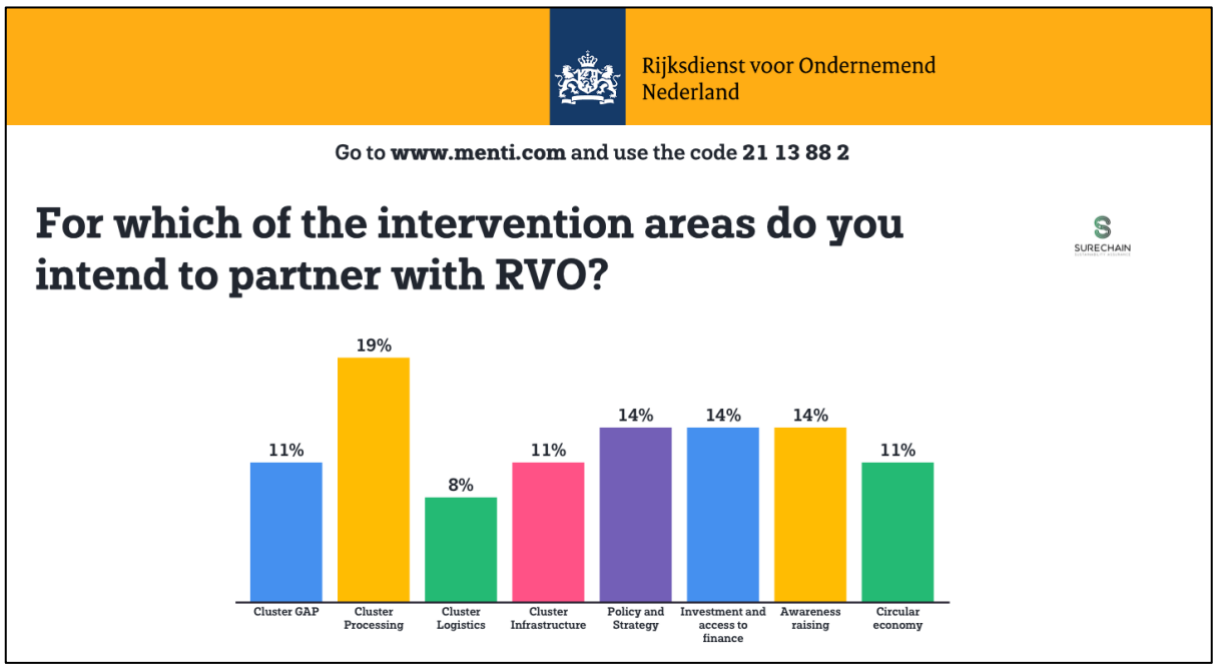
Rijksdienst voor Ondernemend Nederland

Go to **www.menti.com** and use the code **21 13 88 2**

What are the top 3 opportunities for tackling food loss in tomato, onion and chili value chains?

SURECHAIN





Summary of main points raised during discussions

- Issues with transportation (infrastructure combined with long stops)
- High costs of seeds and fertilizers and lack of knowledge on these products
- Corruption in the country
- Non central coordination / strategy is one of the elements that affects the value chains. It is unclear what is expected for the farmers. Corruption is an issue but is also due to the lack of coordination because this provides the opportunity for a middleman to come in. It is important that farmers understand how a product should be handled.
- We need to have a central database that can being all the farmers together. So we know them and we know the quality of the products they produce. The farmer needs to be certified. So that we know the quality of the products they produce. This can also solve the food losses. Because the farmers are aware of the quality standards. International stakeholders should focus on training of smallholder farmers.

- There is this enabling environment that you need in order to come to better outcomes of interventions. Some of the constraints that are not solvable by the program, should still be included if you want to have a holistic approach. So, but how do you solve such problems?
- Traditionally, centrally coordinated strategies have not been very successful in Nigeria. We have to look at economic solutions. We have to find a way to work with economic solutions because that is where the entrepreneurial successes come from. Holistic approach should be done.
- Transportation is critical. Cold chain. Enabling environment is where the strategy comes in. My suggestion is to look at the enabling environment and do the best you can do but focus on the entrepreneurial side. So the transportation facilities etc.
- Agrofair is working on post-harvest tomato losses. We focused in between the field and the market. We found that especially the way the tomatoes were packed and transported resulted in high losses. The best way to transport tomato's is to use plastic crates. Bad roads, bad trucks result in food losses. The tomato value chain is very fragmented, which makes it challenging to introduce something as returnable plastic crates.
- Clear lack of funding in the area. Financial support and financial and business expertise/training is important.
- Tomato value chain: A lot of attention goes to post harvest loss, but lot of loss happens before harvest. Most seeds are lost. Lack of GAP knowledge of farmers. The value chain needs to be repaired all along. Transportation is important. Holistic approach is important.
- It is not one thing we have to focus on. We have to focus on the whole chain. Seed links, transportation, knowledge of farmers on quality, transportation to factories. Different elements in the whole chain have to be perfect. We can help in that to make that process better and more efficient and avoid losses.
- Coordinated efforts is key; we will not see the results we desire to achieve without coordinated efforts. Policies need to be put in simple information and language, so that farmers can understand. Policy incentives and financial backing is needed.
- We need to bring technologies down to the farmers in the rural areas. Opportunity for solar drying.
- Funding and synergy is crucial to combat value chain food losses. Everyone should be coming into play. All the farmers and all the actors of the value chain. Cost of crates is increasing by the day.
- We have to convince the farmers that quality is more important than quantity.

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