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Roadmap to strengthen the vegetables sector in Benin

Exploring business links with the dutch private sector

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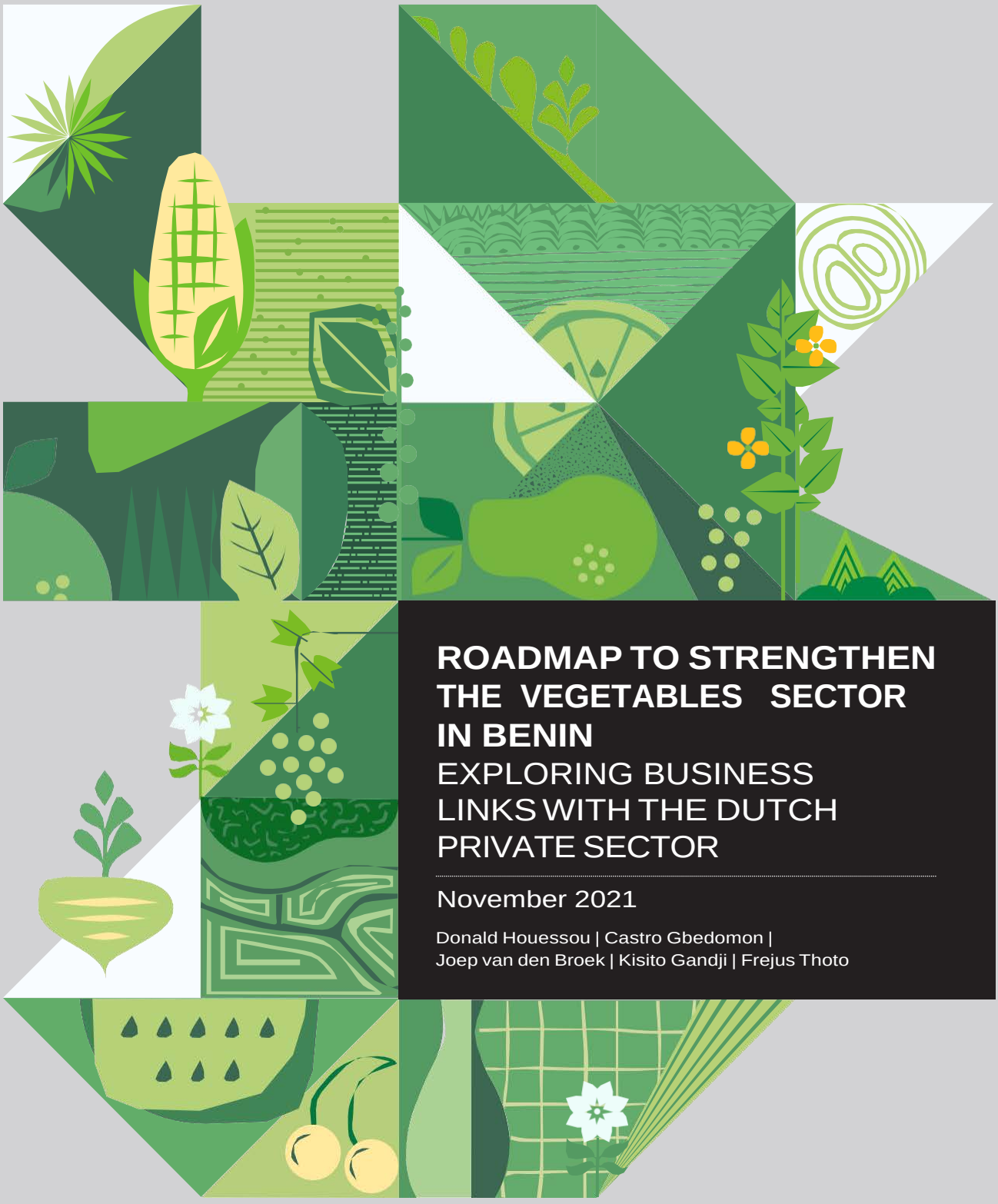

ROADMAP TO STRENGTHEN THE VEGETABLES SECTOR IN BENIN

EXPLORING BUSINESS LINKS WITH THE DUTCH PRIVATE SECTOR

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Content

Executive summary

There is need to strengthen the vegetables sector in Benin. The vegetables sector in Benin is an important agricultural industry that employs thousands of people in urban, peri-urban, and rural areas. Despite the efforts made by local producers – rural and urban – evidence shows that there is still a gap in the supply of vegetables in the country. Indeed, during the last decade, the country witnessed a dramatic growth of its main cities resulting in an increasing demand for food. So far, this demand could only be partly satisfied by the existing vegetables systems that are facing huge constraints such as limited access to quality inputs and equipment (seeds, fertilizer, crop protection products, technologies), lack of secured land, lack of capital, and lack of knowledge and skills, all leading to a missed opportunity in the sector. It is, therefore, high time to strengthen the vegetables sector in the country. Beforehand, there is need to understand what the bottlenecks are, where they are within the value chains, and what opportunities appear to support the sector. To make it happen, this study addressed the knowledge gap and used an interactive and transdisciplinary approach to present the institutional environment, delve into the value chains, and identify the bottlenecks and business opportunities.

The dynamics of the vegetables sector is accompanied by an enabling policy and business environment. There are various stakeholders who are working in the vegetables sector and who have their own interests and accordingly play different roles to support the sector. These stakeholders are the government, the training institutions, the research institutions, the non-governmental organizations (NGOs), the development partners, the agricultural communities, and the private sector. While, the government, research institutions, NGOs, and the private sector strongly support the economic/operation actors of the value chains (producers, processors, traders), they provide different ingredients. For instance, the government makes policies, NGOs train the operation actors, and the private sector supplies inputs. However, the relationships are more complex as there are many direct and indirect interactions between these actors that also influence the dynamic in the sector.

Besides, these recent years found a renewed interest from national policies and development partners to improve the business environment in the vegetables sector. For instance, since 2016, the vegetables sector is among the top priorities sectors of the government to boost the agricultural development in the country. Thus, with the support from the World Bank, the African Development Bank and the International Fund for Agricultural Development, there are specific policy interventions (2014-2024) that support various vegetables value chains across the country, showing a strong signal of the political interest on this sector.

Tomato, chilli and habanero peppers, onion, and carrot make it the top five vegetables of interest for investments. About thirty (30) vegetables are commonly produced and consumed in Benin, including fruit vegetables (43%), leafy vegetables (37%), and root vegetables (20%). To select a top-five priority vegetables, the study consulted various actors from the government, NGOs, producer organizations, and the private sector to score the vegetables on a five-point scale using four identified business-driven criteria: commercial potential, enabling environment, Dutch know-how and strategic interests, and opportunity for intervention and potential for inclusion of women and youth. After ranking them, tomato, chilli and habanero peppers, onion, and carrot make it a top five of priority vegetables that present promising business opportunities in the country.

Fresh vegetables for wholesale markets, regional markets, and high-end markets and processed vegetables for wholesale markets are the four most active value chains in the country. From the top five vegetables selected, their by-products and market destinations were identified to make a long list of vegetables value chains. However, as vegetables are produced together in association or rotation, a combination of products and similar types of markets was made into fresh vegetables and processed vegetables and wholesale markets, regional markets, and high-end markets, respectively. Wholesale markets comprise wet markets and corner shops, regional markets comprise main foreign destinations (Nigeria, Ghana, Togo, etc.) while high-end markets comprise supermarkets, hotels, and restaurants. Next, an estimation of the proportions of the market shares of these value chains generated a top-four value chains as follows: fresh vegetables for wholesale markets (33%), processed vegetables for wholesale markets (17%), fresh vegetables for regional markets (15%), and fresh vegetables for supermarkets, hotels, restaurants (10%).

The four vegetable value chains were mapped to provide clear information on vegetables flows from production to consumption and on

stakeholders involved. The fresh vegetables for wholesale markets involved five main stakeholders: producers, national wholesalers, national semi-wholesalers, retailers operating in corner shops and wet markets, and consumers. Most of the vegetable flows within this value chain are through wholesalers and semi-wholesalers towards wet markets and at a lesser extent corner shops. The fresh vegetables for regional markets involved only three stakeholders: producers, national wholesalers, and exporters. Most of vegetable export flows passed through national wholesalers to foreign wholesalers; Nigeria is the main destination (more than 70%). The fresh vegetables for high-end markets involved four stakeholders: producers, national wholesalers, national semi-wholesalers and end-users (hotels, restaurant, supermarkets). The processed vegetables (dried, cut, powder, juice, mashed or concentrated) for wholesale markets involved six stakeholders: producers, national wholesalers/ semi-wholesalers of fresh vegetables, processors, national wholesalers of processed vegetables, semi-wholesalers/retailers of processed vegetables, and consumers.

Youth (men and women) are active in vegetable production and particularly women in wholesale and retail trade as well as processing. Vegetable production provides an interesting income generating activity for youth because the crop cycle is short, and it doesn't require a lot of land. Given the economic situation, with few formal employment opportunities, many educated youth are turning to agriculture. Still, they face more constraints than adult men, especially where it concerns access to land and credit. Combining trainings with youth entrepreneurship and access to finance could help young people to engage more professionally in vegetable production. Concerning the processing, it is mostly at a small-scale level, showing opportunities for further professionalization and scaling up of tomato and pepper processing. For the latter there are constraints in terms of access to finance to expand their business (investing in hardware and accessing working capital). In addition, the micro-enterprises can improve their performance through more knowledge on food safety, packaging and branding.

Producers, processors, traders/exporters, and consumers are facing some constraints that fortunately also present interesting business opportunities for local and Dutch private sector. Operation actors are facing several constraints in their activities. Producers face poor and non-adapted quality seeds, unspecific and low availability of fertilizers and plant health products, lack of adapted equipment, postharvest losses, and lack of financing, market information and relevant delivery services. Processors face a lack of quantity and quality supply, equipment and packaging, relevant delivery services, and financing as well as a weak market penetration. Traders/exporters face a lack of equipment for storage, cold chain, financing, and relevant delivery services as well as vegetables availability information gap. Consumers face prices volatility due to unstable production. These identified constraints were combined and reformulated into four major bottlenecks as follows: Benin's vegetable sector is characterized by a low input low output model, climate change will cause higher temperatures and more erratic rainfall, there is an increasing demand for consistent supply of quality vegetables that is not being met, and processing of vegetables is small-scale and fragmented with limited access to finance. To address these bottlenecks, four business opportunities were developed on: increasing productivity and storage of onions in Benin, private sector-led climate smart vegetables innovations, dedicated wholesale/retail outlets that source directly from (groups of) farmers, and professional small-scale pepper processing and exports (with a gender focus). It is expected that the business opportunities entice the entry of experienced Dutch private sector to strengthen the vegetables sector in Benin.

1.

Introduction

1.1 Context →

The vegetables sector in Benin is an important industry that employs thousands of people in urban, peri-urban, and rural areas (Ofio, 2008[1]). Vegetables are produced in various systems and locations. They can be classified into four categories: rainfed system, irrigated system, recessional system, and soilless system. The irrigated system is the main cropping system in the country, followed by the rainfed system. Next, there is the recessional system, which is mainly observed in the South Benin, around the Oueme Valley, while the soilless system is observed only in Cotonou and Save. Global development (including urbanisation and increased purchasing power) comes with changes in diets and consumption behaviour and, therefore, is increasing the demand for exotic vegetables such as cabbage, carrot, lettuce, and cucumber.

Despite the efforts made by local producers – rural and urban – evidence from vegetables market investigation in Benin shows that there is still a gap in the supply of vegetables in the country (ACED, 2018[2]). This last decade, the country witnessed a dramatic growth of its main cities resulting in an increasing demand for food. So far, this demand could only be partly satisfied by the existing vegetables systems, including urban gardens (Houessou et al. 2020[3]). Hounkponou (2003), and Adorgloh-Hessou (2006[4]) identified the following constraints in the vegetables sector: poor quality seeds, high pest and disease pressure, inefficient use of fertilizer and pesticides, food safety issues, lack of knowledge and skills on vegetable production, limited access to land due to the building of residential, commercial or industrial areas (particularly in the South of Benin), lack of credit, and lack of equipment and appropriate materials (irrigation technology), particularly in the north of the country. These constraints can be categorized into four main constraints: limited access to inputs (seeds, fertilizer, pesticides, technologies), lack of secured land, lack of capital, and lack of knowledge and skills, all contributing to low productivity. Recently, a study on the market of vegetables in the southern rural Benin added two additional root causes (ACED, 2018) explaining the supply gap: the high perishability of vegetables, and related post-harvest losses, and the low capacity of trade service providers; both leading to a missed opportunity for value addition.

The impact of the Covid-19 pandemic is also unfolding in Benin, where the population was confronted with barriers to movement and trade, causing disruptions in agricultural and vegetables supply chains and consequently exacerbating an already critical local food situation (Gbedomon et al. 2020)[6]. The disruptions limited the supply of inputs and exerted demand pressure on food, resulting in a general increase in agricultural and food prices. In addition, transportation difficulties affected the marketing of some vegetables that wilt quickly because of their high-water content, such as, tomato and nightshade. In the long term, the disruptions might create an economic crisis, a social conflict, and a decline in quality of life in general, if effective recovery measures are not taken. Therefore, there must be a focus on self-reliance when innovating and optimizing value chains.

However, the Covid-19 related measures also had some positive effects on the vegetables sector and food systems in general (ACED, 2021[7]). First, there was a *renewed interest into local inputs supply*. The supply of imported inputs on the market was limited despite the efforts made by producer organizations. As a result, producers turned to the local inputs supply, which was poorly regulated; few seed producers had certified their seeds due to poor regulation and difficulties to access certification. Second, there was *an improved*

[1] Ofio, A. C. (2008). Etude sur les flux des produits maraîchers au Bénin.

[2] ACED (2018) Le marché des produits maraichers au Sud-Bénin. Centre d'Actions pour l'Environnement et le Développement Durable.

[3] Houessou, M.D.; van de Louw, M.; Sonneveld, B.G.J.S. (2020) What Constraints the Expansion of Urban Agriculture in Benin? *Sustainability* 2020, 12, 5774. https://doi.org/10.3390/su12145774

[4] Hounkponou, K. S. (2003) Urbanisation et agriculture : analyse de l'évolution de pression foncière sur les activités de maraîchage dans le Sud Bénin. Cas de Cotonou, Ouidah et Grand-Popo. Thèse d'ingénieur agronome, FSA/UAC, Bénin, 103p.

[5] Adorgloh-Hessou, R. A. (2006) Guide pour le développement de l'entreprise de production et de commercialisation de légumes de qualité dans les régions urbaines et périurbaines du Sud-Bénin. Rapport de consultation, IITA –bénin. 82 P.

[6] Gbedomon, R.C, Aoudji, A., Kaki, R., Houessou, M.D., Thoto, S.F. (2020). Impacts de la pandémie de la COVID-19 sur le secteur agricole au Bénin : implications sur le marché de l'emploi et sur le programme de mentorat « Accès des Jeunes aux Emplois Salariés dans le Secteur Agricole » ; Working Paper, UAC-Dagrivest.

[7] ACED (2021). Promotion de l'agroécologie et du consommer local au Bénin : Leçons d'un dialogue politique.

agricultural productivity. Indeed, with a limited supply of inputs during movement restrictions, producers reduced the area planted and took better care of their production compared to the past when they planted large areas but could not maintain them well. As a result, yields were improved, with subsequent improvements in the profits made by gardeners. Next, there was *an increase in market share for local healthy products.* The Covid-19 crisis demonstrated the importance of building resilient local food systems. Indeed, the implementation of the cordon sanitaire and movement restrictions measures led to 'panic buying', focused on local products. Coupled with the closure of land and air borders, the decline in food imports created a renewed interest in local healthy products by local consumers. This increased the market share of local products and rewarded the efforts of producers. However, after the measures were lifted, imports went back to pre-Covid levels and reduced the trend of local consumption. Altogether, these effects reveal the need to strengthen the vegetables sector – from inputs supply to food production and distribution – in the country.

As described in the Multi-Annual Country Strategy (MACS) and the 2020 annual plan of the Embassy of the Kingdom of the Netherlands (EKN) in Benin, the Netherlands will continue to support initiatives to improve food security as well as sustainable trade and investment. At the same time, EKN would like to attract Dutch investors and stimulate bilateral trade as part of its Aid and Trade agenda. The 2020 and 2021 annual plans explicitly mentioned the following result: "Investment and trade opportunities identified in the horticulture value chain: a) analysis of the political economy; and b) analysis of the potential to invest in the horticulture and seed sectors". Achieving such a result requires sufficient information flow to inform decisions regarding future strategic planning.

Technoserve and BopInc contracted the Netherlands-African Business Council (NABC) to conduct a horticulture study that was finalized in the first quarter of 2020. EKN and RVO concluded that the study's objective was not very clear, and therefore, the outcome was not concrete enough. Information was missing on the following topics: (i) inputs; (ii) production processes and systems; (iii) the political and regulatory environment (including taxation); (iv) agricultural support services: training, education, and knowledge without forgetting technological innovations (e.g ICT4AG, financial services such as Agriwallet); (v) market demand and trends in volumes, quality (raw products and processed products), origins (local and imported), and post-harvest losses; (vi) the distribution/marketing channels (domestic and export); (vii) identification of investment opportunities for Dutch companies; and (viii) gender dynamics.

This study therefore aims to address these gaps in Benin's vegetables sector and identify bottlenecks for Private Sector Development (PSD) and opportunities for Business Development (BD). The study aims to provide insights into how value can be added to the vegetables sector and clarify how value-adding opportunities identified relate to current business or capacity development initiatives in the country.

1.2 Objectives →

The objective of the study is to identify the *bottlenecks and opportunities* to strengthen the vegetables sector in Benin, where relevant through Dutch knowledge, technologies, and expertise. Specifically, the study aims to achieve the following objectives:

Objective area 1: Institutional environment

- Map the stakeholders in the vegetables sector and their roles and interests;
- Analyse government policies and programmes on the development of the vegetables sector and resources assigned to it; and
- Analyse the agricultural support services relevant to the vegetables sector such as extension, skills development, financial services, irrigation equipment, storage, and ICT.

Objective area 2: Value chains

- Identify the value chains in the vegetables sector that are: (1) in line with the interests of the stakeholders (both National and Dutch) and the government; and (2) linked to agroecological potentials, market opportunities, and the producers' technical knowledge gap;
- Present key facts and figures for the production and consumption of the identified value chains (e.g. price of inputs available, average farm size, soil conservation, import/export including data on production and consumption volumes over the last five years);
- Analyse the market demand and tendencies in volumes and quality, distribution/marketing channels (domestic and export) of the identified value chains; and
- Analyse the gender and youth dynamics by providing insights into the challenges and opportunities that come with access to education and inputs, division of labour, and decision-making in the identified value chains.

Objective area 3: Bottlenecks and opportunities

- Learn the lessons from projects in Benin (e.g. PADMAR, 2SCALE, ACMA2, Drops4Crops) and other African countries in the vegetables sector (e.g. HortiFresh in Ivory Coast and Ghana, West Africa Trade Facilitation program) and get to know what are the main pull factors for Dutch private sector to do business in the specific country;
- Map a minimum of four major bottlenecks for local private sector development in the vegetables sector, including Dutch companies that are established in Benin;
- Identify at least four business opportunities and corresponding potential business opportunities linked to Dutch and local companies in Benin;
- Map funding opportunities (informed by discussions with potential investors in the Netherlands/internationally) for each of the four business opportunities; and
- Present four business opportunities of the vegetables value chain that can be further developed.

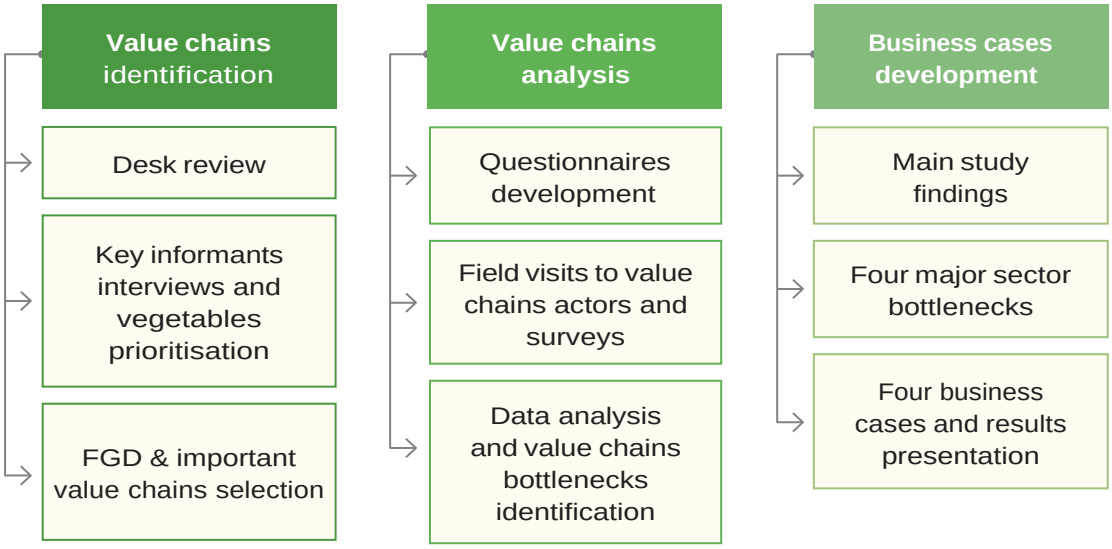
The following results and deliverables are expected:

- An inception report, in the form of a quick scan that presents the research questions, the focus areas, the methodology, and the timeline.
- A report on the vegetables sector in Benin that addresses the following:
  - Analysis of the institutional environment including stakeholders, the support services, and the political economy.
  - Analysis of the vegetables value chains, including the production and consumption patterns, the market behaviour, and the gender and youth dynamics.
  - Bottlenecks and business opportunities for the local and Dutch private sector.
  - Funding opportunities that are linked to identified business opportunities.
- Report presentations:
  - In English for stakeholders in the Netherlands in cooperation with RVO.
  - In French in consultation with the Embassy in Benin.

1.3 Methodology →

The study adopted a three-pronged and iterative transdisciplinary approach (Figure 1) to conduct the activities: value chains identification, value chains analysis, and business opportunities development.

Figure 1 Methodological approach



Value chains identification. This phase included three steps and concluded with a quick scan report. First, the research started with an initial **desk review** of the relevant literature. The search of documents considered materials in both French and English and covered scientific articles and grey literature (projects' reports, evaluation reports, blogs, policy documents) and was conducted both online and through knowledge institutions. The online search targeted well-known databases such as Google Scholar and Scopus to collect relevant documents that match the following keywords: *'horticulture'* OR *'vegetables'* OR *'gardening'*, OR *'urban farming'* AND *'Benin'*. The documents were read and included if there is relevant information to inform the research questions of the study. Although the focus was on Benin, the review also implicitly targeted the Dutch private sector in the vegetables sector and presented their interests in Benin and West Africa. The review further generated a list of vegetables for the country.

Second, the research proposed some **prioritization criteria** (annex 3) **and conducted few interviews** with key informants (annex 1) to inform the scoring. The informants included governmental, civil society, private sector, and farmers organisations. The criteria included the commercial potential (scale of production, competitive advantage, market potential), the enabling environment (business and policy environment, skills environment), the Dutch know-how and strategic interests, and the opportunity for intervention and impact potential. The overall score for each vegetable was the average of the criteria scores (equally weighted); all vegetables scores were compared and ranked to select a top-five of priority vegetables.

Last, four focus-group discussions (FGD) with some economic actors (producers, processors, traders) **selected the most important value chains.** The FGD invited 3 women, and 4 men, including 3 youth and detailed the end-products and end markets to list all possible value chains of the selected vegetables. Thus, with the estimation of market shares (in proportions) with the actors, a final set of value chains that had at least 10% of these market shares was selected for detailed analysis.

Value chains analysis. The second phase detailed the selected value chains and identified the gaps. This phase also included three steps and generated the draft report of the study. First, the team **developed the interview guides** to map the value chains and estimate the margins per value-chain actor, for the selected value-chains.

Second, 18 interviews and 12 **FGDs were conducted** to survey relevant stakeholders from the north and the south along the selected value chains. The geographic focus comprised two main production areas in the south and two areas in the north. The value chain analysis included facilitators, supporters (inputs suppliers) and operators (producers, processors, and traders). Based on the purpose of the study, the emphasis was put on the operators and less on the facilitators. At value chain facilitator and supporter level, we selected two respondents from each stakeholder for interviews. At value chain operator level, we selected at least three actors per value chain element. The discussions mainly focused on the prices of inputs available, average farm size, plant and soil conservation, quality issues, food safety, seasonality, business opportunities/challenges, postharvest losses, import/export, support services, distribution channels, costs estimation, and gender and youth dynamics (main bottlenecks and opportunities for them). The list of participants included in the study was presented in annex 1.

Last, collected **data were analysed to generate the main bottlenecks to be addressed** within the value chains. Quantitative data were used for estimations and gap analysis while qualitative information was used for a brief description of what the main issues were at each of the chain elements. The results generated a long list of bottlenecks and opportunities per value chain segment for further analysis.

Business opportunities development. The third phase identified and developed the business opportunities. This phase also included three steps and generated four business opportunities. First, the main findings of the study were summarized. These findings distilled the main conclusions from the stakeholder and value-chain analyses. This part also presented a long list of constraints and opportunities that were particular to the vegetables sector of Benin.

Second, the section presented **the four major bottlenecks**, which were a combination (or integration) of the constraints and opportunities as presented in the main findings. The four major sector bottlenecks showed the systemic nature of some of the constraints, e.g. around a topic of climate change and sustainable vegetables sector practices, and mismatch between demand and supply.

Last, the report presented four business opportunities that one-by-one addressed the four major bottlenecks. These business opportunities were designed taking into account the following five criteria: critical issue addressed in the value chain, market size, commercial profitability, potential interest from Dutch companies, and impact on women and youth. As such, the criteria try to bring together the needs of the vegetables sector in Benin, the possible expertise the Netherlands has to offer and the development objective of both the government of Benin and the Netherlands. The business opportunities described: (1) the background or problem analysis of the business opportunity (building on the major bottlenecks), (2) the business opportunity (the proposed solution); (3) the anticipated market size and demand for the solution; (4) the potential activities that could kick-start the business opportunity; (5) the target group and geographical scope; (6) the potential partners; and (7) the funding opportunities (taking into account both donor and commercial funding). With respect to donor funding specific emphasis was put on Dutch funding through the available RVO instruments.

The study outcomes (in French and English) were finally presented to Benin and Dutch stakeholders.

2.

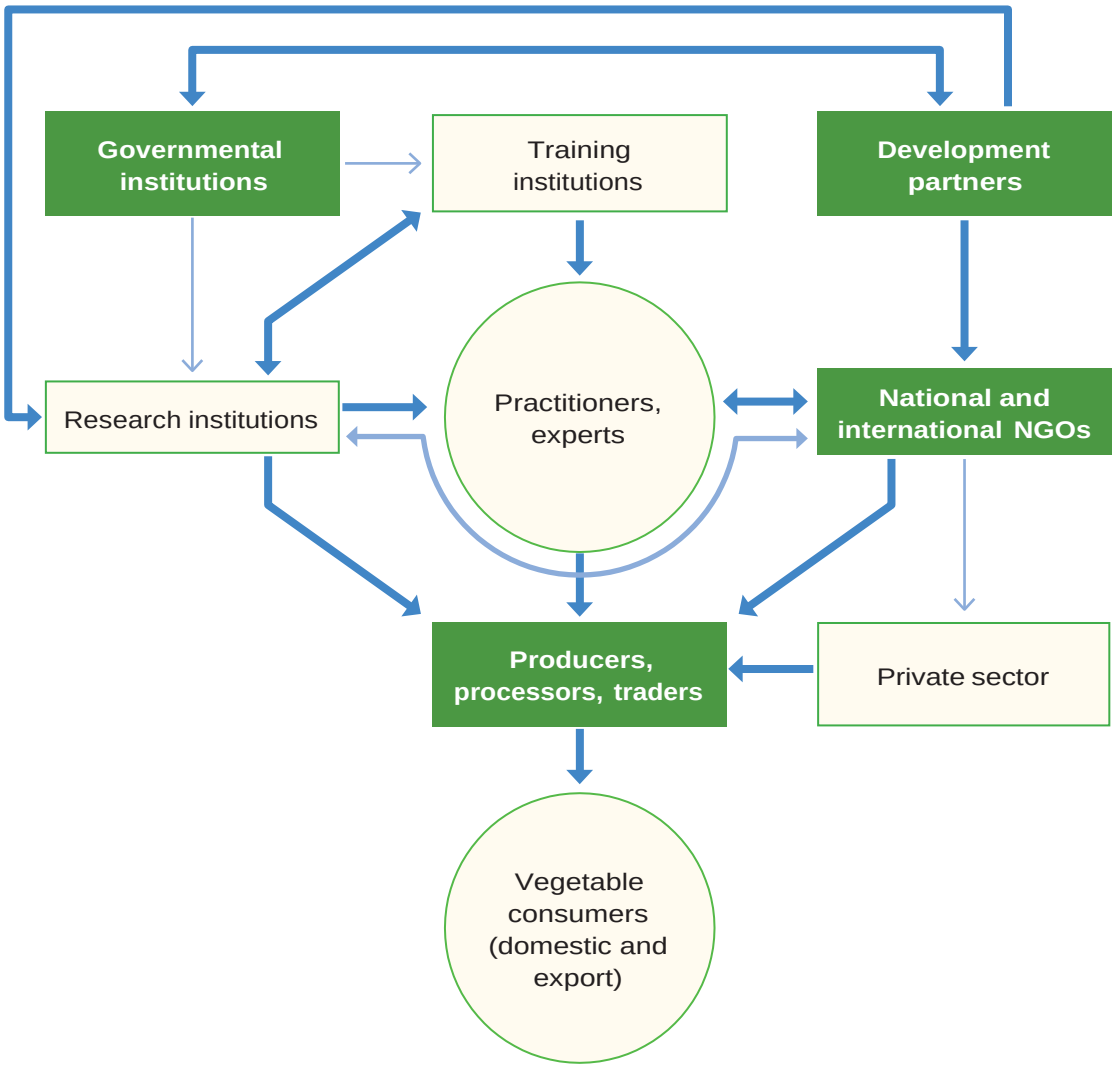
Institutional environment of the vegetables sector in Benin

2.1 Stakeholders in the vegetables sector: diversity, roles, and interests →

The vegetables sector is animated by various stakeholders (Figure 2) government, training institutions, research institutions, non-governmental organizations, development partners, value chains actors, and private sector. These stakeholders have their own interests and accordingly play different roles. Their interests may converge and sometimes diverge depending on the stake. For instance, producers and traders aim to improve their business relationships in terms of products quality and prices but at the same time, can diverge on possible solutions. While producers are interested in greater transparency of product prices, such a solution does interest traders less because price transparency is juxtaposed to the use of market information gap, a main ingredient of the negotiation power of traders.

Figure 2

Relationships (collaborations, power) among stakeholders in the vegetables sector. Bigger blue arrows indicate intense collaborations while smaller blue arrows indicate low collaborations. Green boxes indicate powerful actors in the sector while white boxes indicate actors with less power



The government is the most powerful and a main player in the vegetables sector and mainly contributes through its ministries of agriculture and economy. The Ministry of Agriculture has developed policies and strategies to regulate the sector and tasked the directorate of crops production (DPV) to certify seed production, authorize seed imports, and share approved lists of fertilizers and crop protection products. The ministry has also tasked its regional agencies (ATDA and DDAEP) to control production activities and advise producers, and has developed some specific programmes (PADMAR, PAIA-VO, PAPSFRA, PACER, PACOFIDE) to train, advise, give inputs, and support access to finance for operational actors (producers, processors, traders) in the sector. In addition, the ministry has selected the vegetables sector among the high value-added sub-sectors that can improve food security and livelihoods of thousands of actors and boost the economy. The Ministry of Economy has worked on improving the business climate to improve the interest of foreign investors in agriculture and it has formulated instruments to foster public private partnerships, especially for building industrial agro-processing units, tax incentives for foreign investors, but also the e-registration of companies

There is only one dedicated school for horticulture including vegetables production, located in the National University of Agriculture. The other tertiary institutions (Faculty of Agronomic Sciences of the University of Abomey-Calavi and Faculty of Agronomy of the University of Parakou) blend training in vegetables production with crops production in general. At secondary level, there are 10 agricultural colleges that also train in crops production including vegetables production. Besides, there are various national and international research institutions (like INRAB, GBIOS, CIRAD and World Vegetable Center.) that conduct research on soil fertility management, crop varietal improvement, technical itineraries, and post-harvest handling for vegetables products. These research institutions are less powerful but highly interested in the vegetables sector and also provide practical experience to young graduates in need of skills to enter the labour market. Furthermore, they are involved in many development and research projects (like SAFEVEG, TAERA and PADMAR.) in which they collaborate and share knowledge with producers and processors as well as with relevant non-governmental organizations.

There are various national and international non-governmental organizations working on development and research projects in the vegetables sector which, usually is one of their focus areas (e.g. ACED, SOJAGNON, Hortitechs Développement, OBEPAB, DEDRAS, SNV, Technoserve, Woord en Daad). They provide trainings and support producers, processors, and traders in their activities and business relationships along the value chains. They are in regular contact with value chains actors and are aware of encountered constraints by producers, processors and traders. They have a major influence on value chains actors and are the major actor who voices field challenges to governmental institutions and development partners.

Development partners (EKN, GiZ, Enabel) support the vegetables sector in two ways. First, they fund development and research projects to support value chains actors and private sector development, and second, help to voice field challenges to policymakers. They are also a powerful actor as they provide most of development funds to support non-governmental organizations and value chains actors.

Value chains actors are made up of producers, processors, and traders who are involved in the day-to-day operations of vegetables production and trade. They are the main actors who encounter challenges in the field and for whom various interventions are planned to support their livelihoods. They are organized in national associations (like FENOMA) to voice their challenges and defend their interests. In addition, until 2018, there were a total of 703 producers organisations, including 660 grassroots farmers' organisations, 38 Communal Unions of Market Gardening Cooperatives, and 05 Departmental or Regional Unions of Market Gardening (Agriterra, 2021[8]). Of this number, 15% are in the northern zone (especially in the departments of Atacora and Donga) and 80% in the southern part, which includes 27 communes corresponding to the PADMAR project intervention zone. There is an average of 25 individual members per grassroots farmers' organisations with an average representation of 41.5% women and 46.5% youth. Producers also form the main market base for inputs and equipment suppliers and finance and extension providers i.e., the private sector. Processors, mostly women, operate at a small-scale level and are less organized than producers.

[8] Agriterra (2021). Etude exploratoire sur le paysage coopératif dans la Chaine de Valeur Horticole au Nord et Sud Benin.

Traders, also mostly women, are less organized but have a major influence on prices volatility of the vegetables in the country. They create an information gap on prices to misinform producers and, based on the high perishability of products, dictate their prices to buy the products.

The private sector comprises local and foreign companies and compete with each other for market share. They also collaborate with non-governmental organizations to reach a higher number of producers.

2.2 Ongoing policies and programmes in the vegetables sector in Benin→

The vegetables sector in Benin is gaining an increasing interest from the government and national policies. Since 2016, there has been a high political interest to support value-added crops across the country including vegetables products. For instance, from 2017-2021, the National Plan for Agricultural Investments and Food and Nutritional Security aims to increase by 25% the production of vegetables products that are locally well consumed such as tomato, onion, hot pepper, and gboma eggplant. In that sense, the Ministry of Agriculture through its territorial agricultural development agencies (ATDA) provides seeds and extension services to producers to increase their production. Among the seven (07) territorial agencies that cover the seven agricultural development poles in the country, two (pole 1 in the north and pole 7 in the south) have been identified by the government as priority zones for policy interventions in the vegetables sector. The agricultural development poles 1 (Malanville, Karimama) and 7 (Oueme, Atlantique, Littoral, Mono) present the best agroecological conditions to develop the vegetables sector. Besides, the poles 3 (west Atacora), 4 (Collines) and 6 (Plateau) also present good potential for vegetables production.

As a priority sector, the country developed a national programme for the development of vegetables sector. Furthermore, as urban agriculture is increasingly playing a significant role in urban food security, the country developed a national strategy in 2015 for the development of urban and peri-urban agriculture. The objective of this strategy is to improve the performance of peri-urban and urban agriculture to contribute to food and nutrition security. The strategy also aims to form a framework for poverty reduction where direct actors thrive and contribute to the economic and social development of Benin's cities through secured access to resources and markets, and the professionalization of actors. All these policies aim to support the performance of various segments of the value chains in the vegetables sector.

Incentives for investments by national and foreign enterprises

For local investors, the government set up the National Fund for Agricultural Development (FNDA) to facilitate private investments in the agricultural sector. The fund serves as an instrument for negotiating low interest rates and providing guarantees with financial institutions to finance farmers and agricultural enterprises. The fund also supports and facilitates investments that enable agricultural entrepreneurs to start, consolidate, expand, and professionalize the production, processing, and marketing of agricultural products. In the framework of the Covid-19 recovery measures, the government allocated EUR 150 million to support SMEs and agro-entrepreneurs. However, our interviews showed that the fund’s terms and conditions are not well known and cannot be easily met by small-scale producers. Indeed, as for small-scale producers applying for credits, their files must contain a credit application form, a BIC consent form to be signed at by the financial institution, a proof of activities with invoices, estimates, or other documents, an operating account of the activity, if applicable, an income and expenditure book, the supporting documents for the credit with purchase orders, maritime connections, invoices, estimates and other documents, a photocopy of the identity document, a statement of the various accounts, and an update of the current commitments. Clearly, these conditions are difficult to meet by the majority of farmers. These conditions are even higher for small and medium enterprises which hardly have strong financial and accounting systems, questioning the effectiveness of the fund. For foreign investors, the government is willing to create an enabling business environment that facilitates direct foreign investments by reducing the costs for import/export of agricultural products. It is expected that foreign enterprises improve the level of processing of agricultural products and achieve higher levels of value addition. The government also plans to develop opportunities for Public-Private Partnerships (PPP) but, we did not find any examples of these yet.

Cross-cutting policies affecting the **vegetables sector**

There are a number of cross-cutting policies that support agricultural development, and thereby have implications for the vegetables sector. First, the government developed a seed policy in 2015 that clarified the roles of various actors in the sector. Clearly, the government intends to boost seed production by supporting the private sector – domestic and foreign – in developing and producing new and improved varieties that meet local and climate change constraints, while assuring a regulatory (control and certification) role. In practice, there are local and foreign seed companies operating in the country, but the current state's enforcement is weak, leaving farmers with uncertified seeds. In addition, the seed policy fosters the private sector to develop or fund research projects that aim at addressing constraints encountered by farmers. Coupled with the identified constraints in the vegetables sector by the national agricultural research programme (2018-2025), the government opens the room for private sector investments in developing and trading quality seeds, fertilizers, crop protection products, and irrigation equipment; all indicated in the research programme.

Next, the country developed a national strategy for agricultural mechanization in 2020 that suggests that materials should be adapted to local conditions. Indeed, the strategy indicates that the soil differences among the different agroecological zones do not make it to approve a type of mechanization for the whole country, opening the door for the private sector to innovate and adapt materials to local conditions and the small-scale production level. The strategy also intends to promote the uptake of improved materials by farmers and at the same time encourages private companies to invest in approved and locally adapted materials. This means that there are possibilities to develop and certify locally adapted materials for the vegetables sector; should regulations be effectively enforced. These possibilities also require that there is a ready market base in the country which is not obvious yet as the acquisition of such materials requires some capital and training.

Finally, the country adopted a national strategy for digital agriculture (2021-2025) that aims to improve the performance of agriculture using ICT instruments. The strategy is cross-sectorial and intends to promote where necessary the use of ICT tools to improve the accessibility of timely information on quality inputs supply, good agricultural practices, and market information. It is, therefore, an opportunity to disseminate and promote quality inputs traded by private companies for the vegetables sector.

Interventions supporting the vegetables sector

Some policy interventions are supporting the vegetables sector in Benin and are supported by organisations such as the African Development Bank (AfDB) and the International Fund for Agricultural Development (IFAD). The AfDB financed the *Projet d'Appui aux Infrastructures Agricoles dans la Vallée de l'Ouémé (PAIA-VO,* 2016-2020) to contribute to the food security of the population and increase export volumes and revenues of Benin. In practice, the project aims to develop the production and marketing infrastructure of the lower and middle Ouémé valley (Zou, Atlantique, Oueme) for the promotion of growth-generating crops. IFAD supports the *Projet d'Appui à la Promotion des Services Financiers Ruraux Adaptés (PAPSFRA, 2014-2022)* that aims to facilitate the access of promoters/ entrepreneurs with investment financing and the promotion of high-value crops, including vegetables products. The project covers the entire nation and targets beneficiaries working in the production, processing, and marketing segments. IFAD also supports the *Projet d'Appui au Développement du Maraîchage* (PADMAR, 2017-2024) that aims to sustainably increase the income of vegetable farmers while improving their resilience to climate change. The project focuses on seven departments of southern Benin (Mono, Couffo, Atlantique, Littoral, Ouémé, Plateau, and Zou) and targets about 17,000 vegetables farmers. The project intends to strengthen the capacity of actors involved in vegetables chains (production, processing, and marketing), and supports the rehabilitation and building of some facilities for post-harvest handling (i.e. storage, packaging).

Moreover, there are specific interventions funded by foreign countries in Benin. The government of the Netherlands supported several previous projects in the vegetables sector and currently supports the *Approche Communale* pour le Marche Agricole (ACMA, 2013-2017; 2017-2021), the *Emploi des Jeunes pour une Amélioration de la Sécurité Alimentaire au Nord-Benin* (EJASA, 2020-2022), the Nuffic TMT capacity building training in tomato and hot pepper, the Safe locally produced vegetables for West Africa's consumers (SAFEVEG, 2020-2025), and the HortiBenin (2020-2022). These projects aim to build the capacities of smallholder farmers in the vegetables sector and incite them to adopt good agricultural practices along with quality inputs (seeds, fertilizer, equipment). Besides, the Belgium development agency supports the *Transition Agro-Ecologique par la Recherche Agricole* (TAERA, 2019-2024) and the *Programme d'Appui Au Développement des Filières Agricoles au Benin* (PROFI, 2016-2019), that all include the vegetables sector in their targeted value chains.

Altogether, there is evidence to conclude that the current political and economic environment in Benin is favourable for the development of vegetables, with a strong political will to support the sector.

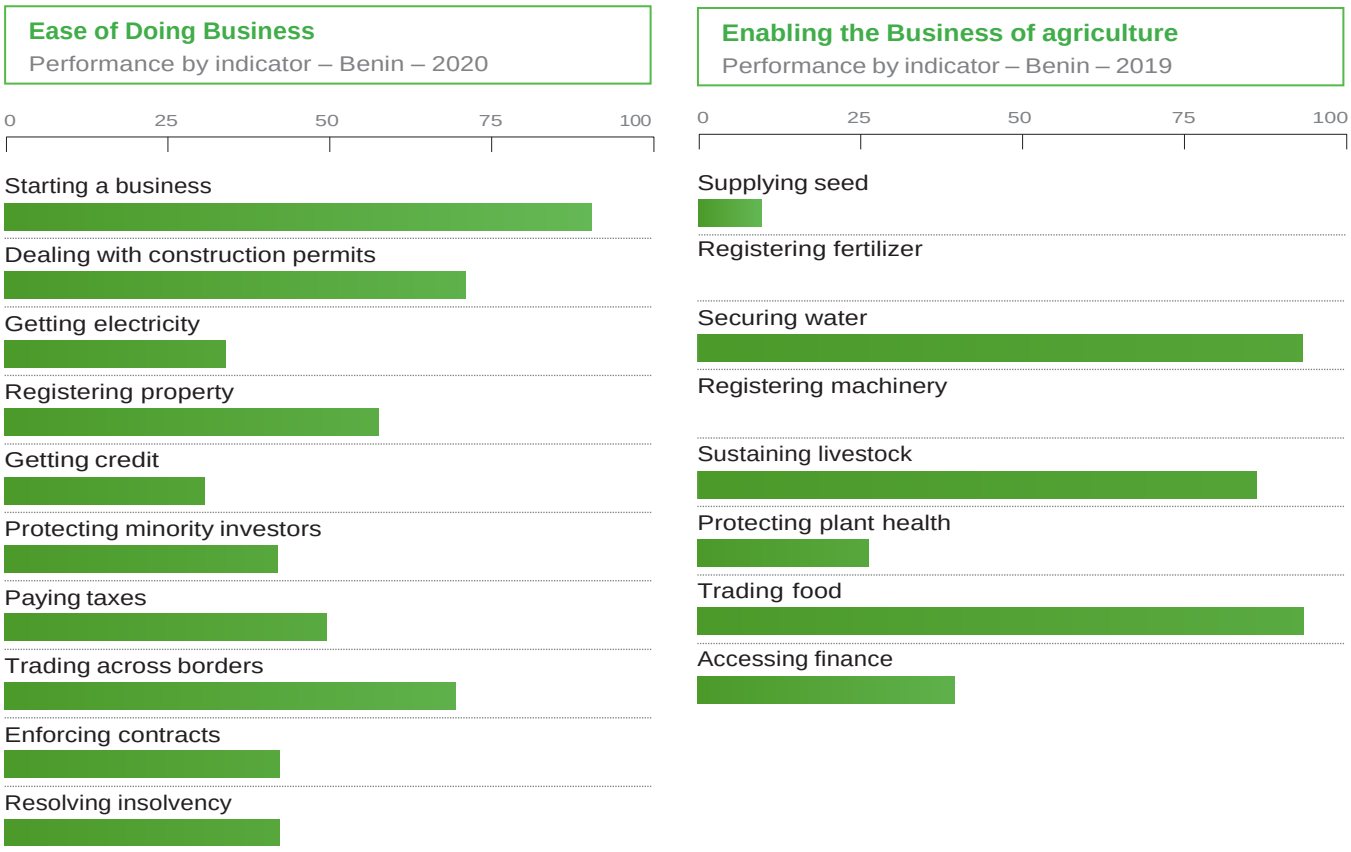
Ease of doing business in agriculture

This section is built on the latest report of the World Bank's Doing Business (DB) 2020 and the 2019 report of Enabling the Business of Agriculture (Figure 3) in Benin. The Doing Business indicators provide objective measures of business regulations and their enforcement across 190 economies. For 2020, the major reform to ease doing business in Benin was in registering property. The country improved the reliability and transparency of the land administration system by publishing official statistics on land transactions and land disputes for the previous calendar year and committing to deliver a legally binding document within a specific timeframe. Therefore, Benin's score rose from 51 in 2019 to 52 points out of 100, and the country improved its rank, moving from 153rd to 149th out of 190 economies, showing that the country is improving its business environment, though the overall standing is still low.

Figure 3 gives an overview of key Doing Business indicators for Benin. The figure shows that it is relatively easy to start a business in the country, and that it is also quite easy to obtain necessary permits to operate a business. In addition, registering property and trading across borders can be done quite fast, though there is need to improve conditions especially related to tax payment. Getting credit for local enterprises is difficult. Corporate transparency and contract enforcement are still weak, necessitating that stronger systems are put in place to protect investors.

Although the 2021 DB report is delayed, the government continues to pursue reforms to improve the business environment. For instance, huge improvements were made to digitize, ease, and speed the process of establishing a business, obtaining a building permit, obtaining legal rights credits, connecting to electricity, transporting property, paying taxes, and trading across borders. The latter was achieved through the development of a Single Window of Foreign Trade, simplifying all operations of foreign trade. Moreover, the reforms promoted gender equality and abolished marriage requirements for women when obtaining identity documents.

Figure 3 Ease of doing business (left) and Enabling the business of agriculture (right) in Benin



The Enabling the Business of Agriculture report assesses whether governments make it easier or harder for farmers to operate their businesses. The indicators provide a measure of progress and identify regulatory obstacles to market integration and entrepreneurship in agriculture. The overall EBA score for Benin is 33 out of 100 and shows that it is harder for farmers to operate their business. The seed supply indicator shows that regulations that support the timely release of varieties for use by farmers are almost absent, *exposing gardeners to unregistered varieties.* However, plant breeders' rights are protected for 25 years. Registering fertilizer in the country is difficult and it is strictly prohibited to import fertilizer without permit, *leaving gardeners with few options*. However, importing agricultural machinery is possible though uncontrolled. Regarding plant health, it is difficult for farmers to access crop protection products, which has negative impact on vegetables yields. At the same time, trading food regulations are well controlled and help gardeners to trade vegetables without obtaining trader-level licenses. However, the level of quality control of food locally commercialized is still weak. Lastly, getting access to finance is difficult for farmers and companies, and obtaining finance is subject to strict regulations.

3.

Vegetables value chains in Benin

3.1 Selected value chains →

3.1.1 Top priority vegetables →

About thirty (30) vegetables (annex 2) are commonly produced and consumed in Benin, including fruit vegetables (43%), leafy vegetables (37%), and root vegetables (20%). The thirty vegetables were scored on a five-point scale (5 = Very High; 4 = High; 3 = Medium 2 = Weak; 1 = Very Weak), using four identified business-driven criteria: commercial potential, enabling environment, Dutch know-how and strategic interests, and opportunity for intervention and impact potential. Afterwards, they were ranked, and generated a top five of priority vegetables (Table 1).

Table 1

Top five vegetables for investments in Benin

Rank	Vegetables	Score
1.	Tomato	4.79
2.	Chilli pepper	4.48
3.	Habanero pepper	4.48
4.	Onion	4.48
5.	Carrot	3.85

The top-five is part of the well consumed vegetables in rural and urban Benin. From countryside to the densely urban area, these vegetables are common ingredients for most cooked foods. The periodic import of these vegetables form Burkina-Faso and Niger confirms the potential of the national demand, thereby, shows a potential for import substitution in the country. The top-five also has a great potential for the regional markets based on the increasing demand from neighbouring countries (Nigeria and Togo). For example, discussions with some economic actors along the value chains indicated the potential to take a greater share of the market if production is increased, *by improving agricultural production practices.*

In addition, there is an enabling environment – business and policy – that fosters local and foreign companies to invest in the vegetables sector. For example, not only, food trade regulations are flexible and public investments (in road and market infrastructures, training) are made, the country also presents a stable and safe environment to operate and reach bigger regional markets such as Nigeria, as part of the free people and goods movement policy within the Economic Community of West African States (ECOWAS). Even if the latter policy was fragilized by the previous border closure (2019-2020) between Nigeria and Benin, *it presents new investment opportunities for postharvest handling technologies*. Indeed, the border closure created some disruptions in the fresh vegetables supply to Nigerian markets, leading to considerable postharvest losses, especially for tomato. Furthermore, Nigeria and ECOWAS markets at large are far from saturation and still present a great potential, as long as, the market behaviour is monitored.

Nonetheless, vegetable production still faces a number of challenges such as the absence of specific fertilizers and crop protection products. Indeed, besides seed supply that is quite open for business entry, regulations concerning fertilizers and crop protection products are strict and difficult to satisfy, *but not impossible, showing a potential for investments*. In addition, tomato and onion production during dry season is difficult because current vegetable varieties are sensitive to heat, high relative humidity, and pest pressure, *opening the way to supply more resistant varieties;* East West Seeds company confirmed the business opportunity and is already conducting some trials in this respect. Regarding machinery, the low-intensification level and small-scale farming systems require low-tech and low-cost irrigation systems. Currently, gardeners source their equipment from informal suppliers, who mainly import from Nigeria, India, and China. The dominance of the informal market is due to the uncontrolled regulations in place.

Finally, the selected vegetables are produced and processed by youth, women, and men. Thus, policy and/or business interventions have *the potential to impact the livelihoods of these groups (women and youth).* Specifically, as evidence shows that youth are involved in the activity, especially urban gardening, the vegetables sector presents a nice opportunity to target this powerful group and increase employment. Besides, the few online marketplaces that sell vegetables are mainly managed by youth, presenting a room to target this group. More, processing is dominated by women and is, therefore, a segment that can target businesswomen.

3.1.2 Top priority vegetable value chains →

The focus group discussion (FGD) with 3 women and 4 men, including 3 youth, identified end-products and end-markets for the selected vegetables, corresponding to about ninety value chains that were categorised into nine large value chains. The categorisation combined the vegetables together (as gardeners produce them together), used the main formats of the end products (fresh, dried, and processed), and crossed them with the end markets. End markets include local ordinary markets (corner shops, big markets), local high-end markets (supermarkets, hotels, and restaurants), and regional markets. The resulted large value chains were prioritised and ranked based on the estimation of the proportions of their market share by stakeholders (Table 2).

Table 2

Vegetables value chains categorization and prioritization

End-product	End Market	Weighting (%)	Ranking
Fresh	Wholesale markets (corner shops, big markets)	33	1st
	Supermarket, hotels, restaurants	10	4th
	Regional markets (Nigeria, Niger, Mali, Togo, Senegal)	15	3rd
Dried (including cut)	Wholesale markets (corner shops, big markets)	08	5th
	Supermarket, hotels, restaurants	01	9th
	Regional markets (Nigeria, Niger, Mali, Togo, Senegal)	04	8th
Processed (powder, juice, mashed, concentrated, fried, fiber, oil)	Wholesale markets (corner shops, big markets)	17	2nd
	Supermarket, hotels, restaurants	05	7th
	Regional markets (Nigeria, Niger, Mali, Togo, Senegal)	07	6th

Accounting for a minimum of 10% market share, four priority value chains were selected, as follows:

- Fresh vegetables (tomato, chili, habanero, onion, carrot) for wholesale markets ;
- Processed vegetables (tomato, chili, habanero, onion, carrot) for wholesale markets;
- Fresh vegetables (tomato, chili, habanero, onion, carrot) for regional markets; and
- Fresh vegetables (tomato, chili, habanero, onion, carrot) for supermarkets, hotels, restaurants.

3.2 Vegetable value chains analysis →

3.2.1 Value chains maps →

Vegetable value chains were mapped to provide clear information on vegetable flow from production to consumption and on stakeholders involved as well as functions performed along the value chains.

The fresh vegetables value chains including local wholesale markets, local high-end markets and regional markets dominated the vegetable marketing in Benin, accounting for almost two-thirds of the vegetable total market share in Benin. The fresh vegetables for wholesale market value chain (VC1) accounted for about 33% of the vegetable total market share and involved five main stakeholders including producers (farmers and gardeners), national wholesalers, national semi-wholesalers (connecting national wholesalers and retailers), retailers operating in corner shops and big markets, and consumers (Figure 4). Irrespective of vegetables, there was a slow flow of products moving straightforward from producers to consumers through corner shops. Most of the vegetable flows within this value chain are through wholesalers and semi-wholesalers towards formal markets and at a lesser extent corner shops (Figure 4).

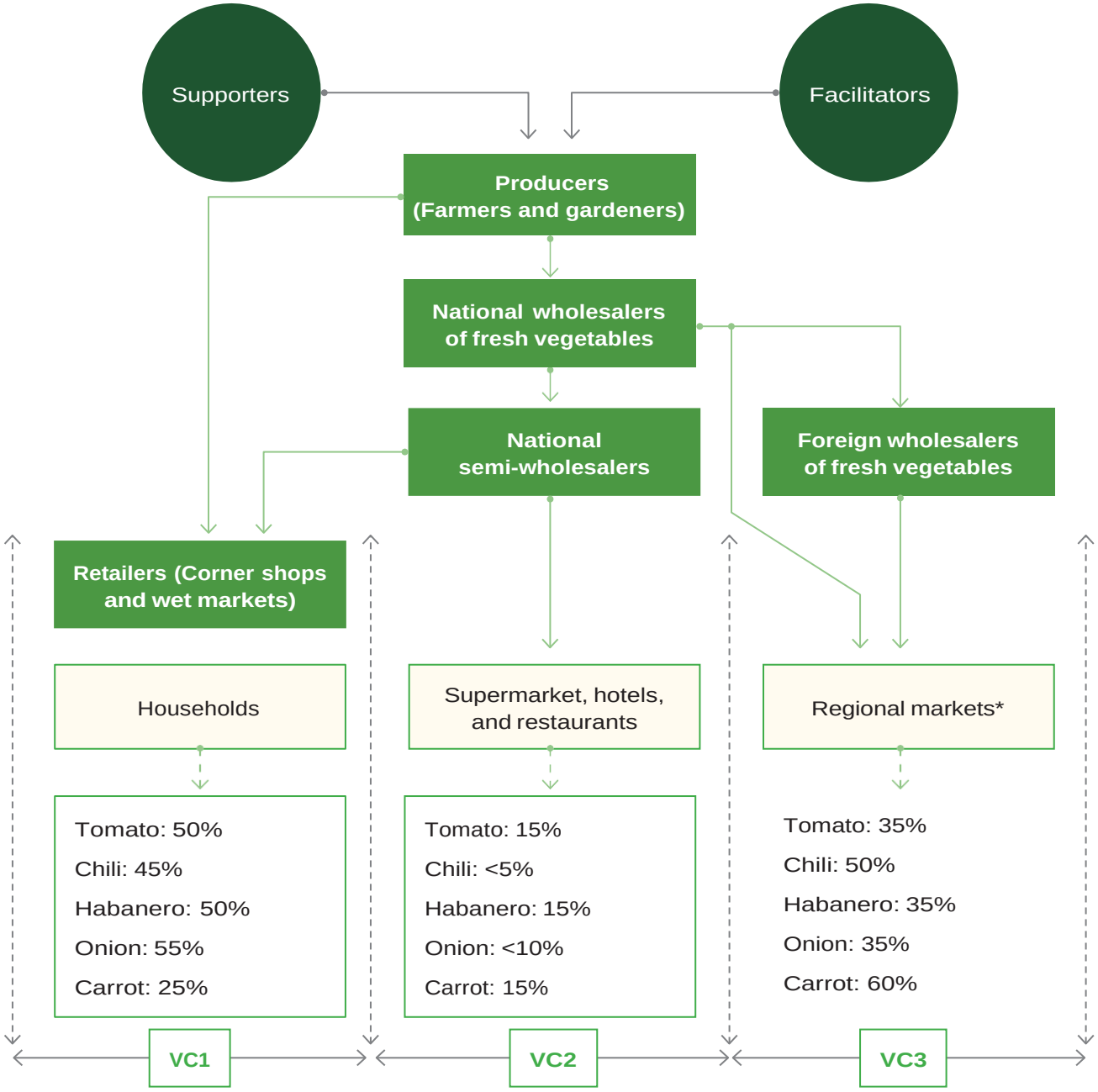
The fresh vegetables for regional market value chain accounted for 15% of the vegetable total market share in Benin, involved only three stakeholders including producers (farmers and gardeners), national wholesalers and exporters. Most of vegetable export flow (tomato, chili, habanero and carrot) passed through national wholesalers to foreign wholesalers from Nigeria. Only a small share of vegetable flow (chili and habanero) passed to other countries (Togo and Ghana), and operated by national wholesalers.

As for the fresh vegetable for high end markets value chain, the market share was about 10%. The value chain involved four stakeholders including producers, wholesalers, semi-wholesalers and end-users (hotels, restaurant, supermarkets).

There are also facilitators and supporters in the vegetables sector in Benin. Facilitators are not-profit actors who provide regulations, extension services, research and training to support the operation actors (producers, processors, traders). Supporters are for-profit actors who provide seeds, fertilizer, crop production products, equipment, finance, assurance, etc.

Figure 4

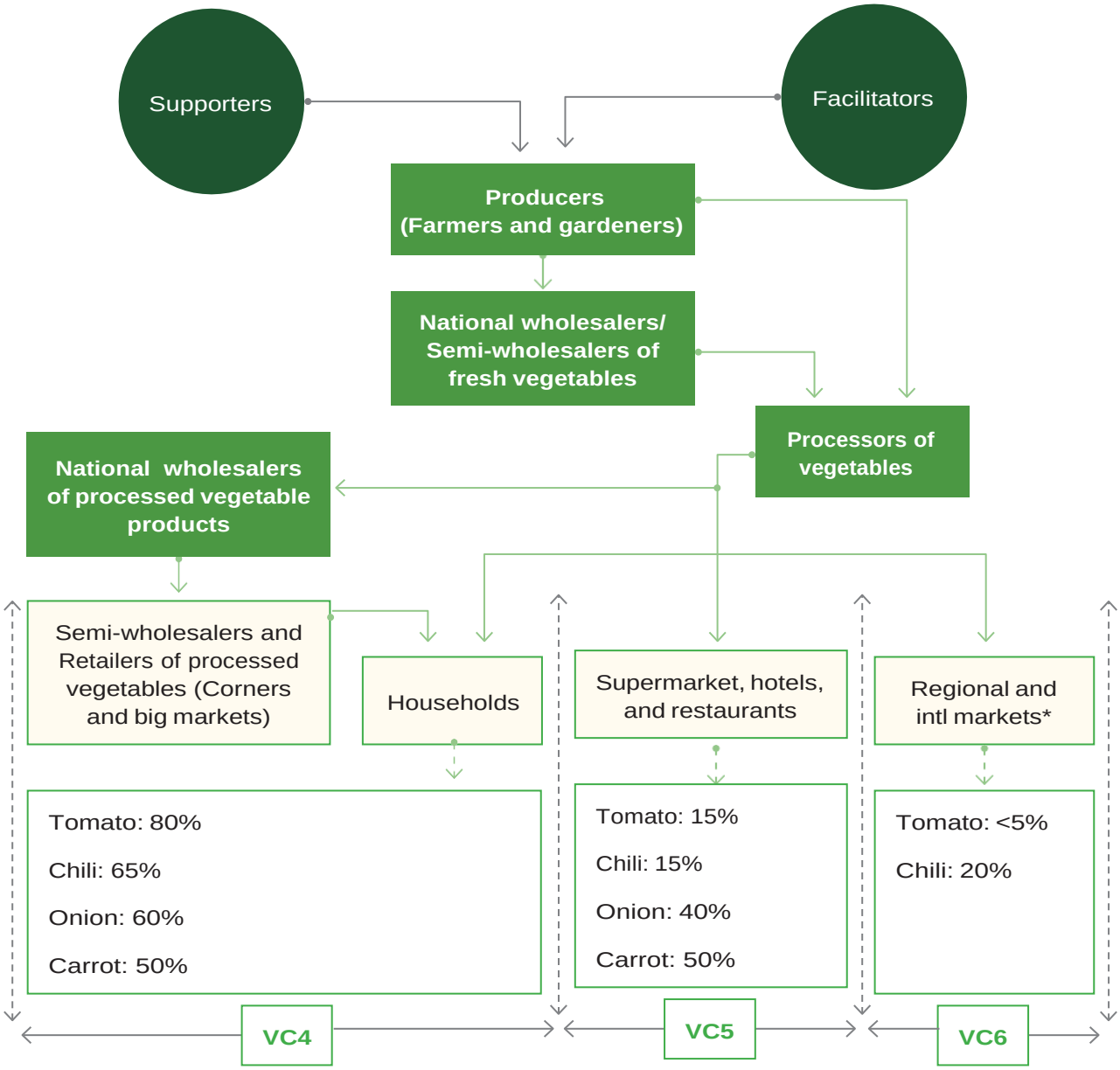
Maps of fresh vegetables value chains: VC1 = for wholesale markets (corners markets and wet markets); VC2= for high end markets (supermarkets, hotels and restaurants); VC3 = for regional markets; *regional markets include Nigeria, Togo, Ghana and Niger



Apart from fresh vegetables, the value chains of processed vegetables products (dried, cut, powder, juice, mashed or concentrated depending on the vegetable) are emerging with about 27% of the total vegetable market share in Benin (Figure 5). The value chain of processed vegetables for wholesaler markets (VC4) dominated with 17% of the total vegetable market share and involved about six main stakeholders including producers (farmers and gardeners), national wholesalers and semi-wholesalers of fresh vegetables, processors of vegetables, national wholesalers of processed vegetable products, semi-wholesalers and retailers of processed vegetable products, and consumers of processed vegetable products. The other processed value chains (VC5 and VC6, not detailed in this report) showed low flow of products, corresponding to 5% and 7% of the vegetable total market share respectively for high end markets and for export.

Figure 5

Maps of processed vegetables value chains: VC4 = for wholesale markets (corners markets and big markets); VC5 = for high end markets; VC6 = for regional markets; *regional and international markets include Togo, Niger, Mali, Senegal, DRC, UE, USA



3.2.2 Consumption of vegetables and by-products →

State of consumption

According to the actors along the vegetables value chains, the trend of the demand of vegetables and vegetable by-products in Benin varied across vegetables. The demand for habanero and chilli pepper is stable over the last five years, while the demand for carrot and onion is increasing. As for tomato, the demand is somewhat decreasing, as tomato is being progressively replaced by onion in recipes especially during dry seasons. The holiday periods (July-September and December) were months of high consumption of vegetables. Inversely, October-November, January-March were the lowest months of consumption.

A recent study by ACDD (2019) estimated the national demand of different vegetables (Table 3) including three of the five targeted vegetables (Tomato, Chilli pepper and Onion), using the consumption needs. Tomato had the highest demand, followed by onion and chilli pepper. For all the three vegetables, the domestic demand was largely unsatisfied. Although the gross supply of tomato was higher than the demand, only 79.4% of the latter was satisfied due to the important postharvest loss. Only 63.5% and 35.5% of the demand respectively for Chilli pepper and onion was satisfied. Regarding habanero and carrot, the trends were globally the same, with only 60% and 70% of demand satisfied respectively for habanero and carrot according to vegetables actors. As results, there is a huge gap on the vegetable market in Benin for the five vegetables and especially for onion, habanero and chilli pepper and to a lesser extend for carrot and tomato.

Households' consumption and preferences

Households' consumption accounted for about 90% of the total vegetable consumption. Tomato, onion, habanero, and chilli pepper frequently appear in almost all local meals and recipes (tomato sauce, groundnut sauce, palm sauce, Vernonia sauce, gboma sauce, amaranth sauce, etc.) in households. The form of consumption (fresh or mashed/concentrated) and the frequency of consumption varied by location (rural vs urban) and wealth status (poor vs rich). In general, the consumption of all targeted vegetables is lower in rural areas compared to urban areas (Table 4). Carrot is almost exclusively consumed by urban households due to consumer preference and culinary behaviour. In urban areas, poor households relied more on dried chilli pepper and imported mashed/concentrated tomato as an affordable alternative to fresh habanero and tomato. Wealthier households (in both rural and urban areas) consumed fresh tomato, habanero pepper, onion, and carrot. However, at some times of the year, they used mashed/concentrated tomato either to colour the sauces or to compensate for the scarcity in fresh tomato.

Table 3

Estimation of national demand and supply of vegetables

Variables	Demand (tons)	Gross supply (tons)	Estimated losses (tons)	Volume sold (tons)	Deficit (tons)
Tomato	267 969	303 892	91 168 (30%)	212 724	- 55 245
Chilli pepper	107 188	75 721	7 572 (10%)	68 149	- 39 039
Onion	160 781	71 147	14 229 (20%)	56 918	- 103 863

Source: ACDD, 2019

Table 4

Estimation of national demand and supply of vegetables

	Tomato	Chilli pepper	Habanero pepper	Onion	Carrot
Rural (kg/year/person)	15-30	15-25	5-12	15-20	<1
Urban (kg/year/person)	50-75	8-10	18-20	40-65	5-8

Source: Trends from focus groups discussions 2021

Household preferences for vegetables are mainly driven by the appearance of vegetables (size, shape, freshness, colour, condition, etc.), and much less on vegetable variety (local or improved) and provenance (i.e., conventional production versus organic production). In general, consumer households are more inclined towards volume than quality. In few cases, some consumers are willing to offer a better purchase price when the products are fresh, of good quality appearance, or when they come from organic production.

Hotels and restaurants' consumption and preferences

Hotels and restaurants (named high end markets in this report) consumed less than 10% of the vegetable production directed to domestic market. They consumed mainly tomato, chilli pepper, habanero pepper, onion, but less carrots. Basically, they used more fresh than processed vegetables. However, mashed/concentrated tomato is also used to improve the colour of sauces (red sauces are well appreciated by clients). The use of dried chilli pepper in sauces becomes important when the habanero pepper is scarce and expensive. However, chilli pepper powder is put on tables for clients. Carrot is used in salads and fried rice and becomes a substitute when tomato is scarce and expensive. Hotels and restaurants used to buy vegetables at corner shops and wholesale markets depending on the volumes. Wholesale markets include, for example, Dépôt market and Arzeke market in Parakou (North Benin), Mawoulé market, Dantokpa market, Mènontin market and Akassato market in Abomey-Calavi and Cotonou (South Benin).

Hotel and restaurants had no preference in terms of vegetable varieties of tomato (local or imported). However, they preferred onion from Northern Benin (Malanville) which is white and bigger than the red onion produced in the southern Benin (Grand-Popo). The red onion oxidizes faster and turns black and is then not appropriates for some recipes (i.e salads). As for carrot, hotels and restaurants preferred locally produced carrots which are smaller but with a long shelf life.

Constraints

Supermarkets, hotels, and restaurants indicated prices volatility as a main constraint in the consumption of the vegetables. They suggested that farmers produce all the year and increase their production to make the vegetables regularly available. They also found it difficult to conserve some varieties of tomato, like *tounvi* which is highly perishable. Further, they indicated that some acidic tomatoes are entering the market, which reduces their purchases. They, therefore, suggested to support farmers in organic production and using quality seeds that tackle these difficulties.

3.2.3 Distribution and markets of vegetables and by-products →

Vegetables in Benin are distributed through domestic markets (corner shops, big markets, high-end market, e-commerce) and export markets (both regional and international).

Domestic markets of vegetables

The distribution of vegetables in domestic markets is operated by pre-collectors, wholesalers, semi-wholesalers, retailers, supermarkets and more recently online vegetable shops.

Pre-collectors visit dozens of farms and gardens to secure and aggregate production from different farms and vegetables sites. Vegetable pre-collect activities require physical efforts and are therefore mainly operated by men, including young men.

Wholesalers were mainly adult women (70%) —in average 35 - 50 years old— but also men. They collected vegetables from pre-collectors or directly from farmers/gardeners. Most of wholesalers and also semi-wholesalers were located in South Benin and supplied wholesale markets (Photo 1) in Abomey-Calavi (Akassato market), Cotonou (Dantokpa, Menontin), Porto-novo (Ouando), et Seme (Krake market).

Photo 1

Some vegetables in wholesale markets

Both wholesalers and semi-wholesalers indicated about 20-30% loss of vegetables, mainly for tomato and habanero. They used various sale measurements including various baskets (50 kg, 150 kg, 250 kg) for tomato, and bags (50 kg, 100kg, 150kg) for onion, chilli pepper, habanero pepper, and carrot. Operations costs include vegetable purchase, cleaning, sorting, packaging, transport and taxes, varied from 50 – 60% of the total revenue.

Wholesalers and semi-wholesalers supplied retailers in corner markets (informal neighbourhood markets) or in formal local or national markets (i.e. depot and Anzeke markets in Parakou, Dantokpa, Akassato, Godomey, Staint michel, menontin in Cotonou; Ouando in Porto novo) (Photo 2). Semi-wholesalers and retailers were also dominantly women but younger.

Photo 2

Some vegetables in corner markets

Due to the extreme variability of the vegetable production along the year, vegetables selling prices are highly volatile, with a very remarkable difference between floor and ceiling prices (Table 5). Irrespective of the zones (South or North Benin), the price volatility was extreme for tomato (1400% of variation), onion (566%) and of less concern for carrot (33-100%). The price volatility is also significant for chilli pepper (400-900%) and Habanero pepper (300-500%) and more pronounced in the Northern Benin compared to South Benin.

Table 5

Selling prices of vegetables in South and North Benin along the year

Area	Vegetables	Floor price (FCFA/Kg)	Celling price (FCFA/Kg)	Variation (%)
South	Tomato	28.57	428.57	1400
	Dried chilli pepper	30	150	400
	Habanero pepper	25	100	300
	Onion	120	800	566.67
	Carrot	250	333.33	33.33
North	Tomato	25	375	1400
	Dried chilli pepper	32	320	900
	Habanero pepper	80	480	500
	Onion	120	800	566.67
	Carrot	300	600	100

The retail trade of fresh and processed vegetables in supermarkets is a recent practice and was observed mostly in main cities of South Benin (Abomey-Calavi, Cotonou and Porto Novo). According to the supermarket's tenders, this specific supply of vegetable arises in response to new demand from expatriates and a middle-class of consumers. Supermarkets (Azima, Soditex, Erevan, Benin marché, etc.) proposed fresh and/or processed vegetables at various format and prices. Supermarkets were generally supplied directly by gardeners (for fresh vegetables) and processors (for vegetable by-products) under a non-binding "dépôt-vente" agreement. Under such contracts, producers/processors and tenders of supermarkets agree on a fixed price—wholesale price. Unfortunately, producers/processors have no control on the final price proposed to clients — the price is inflated by 10% to 50%.

Export markets

According to the vegetables sector stakeholders, there is an increasing trend of fresh vegetables export to the regional markets mainly Nigeria (70%) and Togo (10%) and processed vegetables to Ghana, Senegal, Mali, DRC, etc. In North Benin, the most exported vegetables (in volumes) are onion, dried chilli pepper, habanero pepper and tomato. In South Benin, the most exported vegetables are tomato, dried chilli pepper, habanero pepper and carrot. Exports was operated by road transport to Nigeria, Niger, Togo, and Ghana, but by air freight for Gabon, Senegal, DRC and other destinations.

Vegetable export was mainly operated by men (80%). Youth are less presented in this segment mainly due to the high financial investment required and the need to have a good connections and network in partnering countries. Exporters of fresh vegetable (tomato, carrot, habanero pepper) are mostly foreign wholesalers from Nigeria, Niger, and a lesser extent from Togo. Exports to Togo and Ghana were mainly operated by national exporters.

Exporters also reported about 20-30% vegetable loss. Customs fees are almost the same for 250 kg bags as for 100 Kg bags, then vegetables are generally packaged in 250 Kg bags to cross borders. Total operations costs, including vegetable purchase, sorting, cleaning, transport, and custom fees, were estimated to 50-60% of the total revenue. The vegetable selling price at export was twice the domestic selling price when vegetables are delivered at the borders of Benin, and three times the domestic selling price when delivery is made in the export destination countries. Probably, this represents an interesting business opportunity as also confirmed by exporters who indicated that foreign traders are able to pay a higher price to collect products as they avail of vibrant markets in their countries (Nigeria, Gabon, etc.).

Constraints

Traders face a number of challenges in their activities. First, there is the *lack of information on vegetables availability* to facilitate the collection. Indeed, there is no information source to inform the traders on the regions and producers that avail of vegetables. Solving this challenge requires to digitally interconnect the actors by updating production information. This role can be played by the ATDAs that are in contacts with producers. However, there are some private sector initiatives (JINUKUN Store, Premium Hortus) that offer platforms to connect producers to buyers and charge 20% on top of the selling price. Second, there is *the heterogeneity of sale units.* Traders indicate that there are dozens of units across the country, making the activity risky and unpredictable in terms of profits. This challenge requires to harmonize the units of measurement by using the international standard of kilogramme. The traders indicated the ongoing discussions with the ministry of agriculture in order to approve the decision by the end of 2021. Third, there is a *difficult access to packaging materials.* Locally, packaging materials are not available, and the use of inappropriate bags (lack of ventilation) spoils the products. Currently, traders import materials from Ghana and Côte d'Ivoire but there is still a need to build a local packaging manufacturing factory. Fourth, there is a lack of cold chain. Traders face the challenge of conserving fresh products for a longer period at their appropriate temperature. Therefore, building cold rooms per hotspot may help the activity. Fifth, appropriate means of transportation of vegetables are unavailable. The existing means of transport are not specific and combine all agricultural products together. A solution may be to import appropriate and refrigerated means of transport to cope with Benin climate. Last, there is a *lack of financing options* that impede traders to develop their activities and build business partnerships with foreign enterprises.

3.2.4 Processing of vegetables →

Processing operational actors

Vegetable processing is still embryonic and artisanal. It consumes a very limited volume (<5%) of the total vegetable production in Benin, with tomato being the most processed vegetable. Vegetable processing is poorly developed in North Benin where tomato, chilli pepper and onion are just dried. In south Benin, vegetable processing is more developed and in expansion (Table 6; Photo 3). Processing units are of small size and family based. Only one big processing unit — SOTI Group[9], a multinational installed in Benin since 2014—processes tomato into concentrated products with the commercial name « Mamy ».

According to the vegetables stakeholders there is about 500 vegetable processors in Benin, most of them located in the department of Atlantic and Littoral. Processors were mainly women (> 75%) aged from 25 years with higher education (most with university level). In the department of Ouémé-Plateau there was observed a prominent representation of young men (40%) in processing. Vegetable processors were motivated by the high postharvest loss of vegetable and high volatility of fresh vegetable along the year.

Regarding professional organizations, there are no formal and operational vegetable processors' associations in Benin. In the south, the *Projet d'Appui au Développement du Maraîchage (PADMAR)* supported the creation of departmental associations of vegetable processors in the departments of *Atlantic, Littoral, Ouémé, Plateau, Mono,* Couffo and Zou. The role of these associations is to federate efforts, find markets, seek support in terms of materials and equipment, facilitate access to credit, and support the acquisition of inputs, all of which will contribute to the reduction of post-harvest losses. However, these associations are not officially functional yet. In the north, there are no associations but only village cooperatives and sometimes by district.

[9] Located at Gbetagbo in the commune of Abomey-Calavi, Tel. +229 65669701

Table 6

Processed vegetables in Benin

	Tomato	Chilli pepper	Onion	Carrot
South Benin	Dried/Cut	Dried	Dried/cut	Dried/cut
	Powder	Powder	Powder	Powder
	Juice		Mashed	Oil
	Mashed			Fiber
	Concentrated			
North Benin	Dried/Cut	Dried	Dried	

Photo 3

Some processed products of vegetables (seasoned powder of chilli pepper on top and mashed onion and tomato on bottom)

Processing of vegetables

The average volume of production per processing unit was estimated at 500 – 1,500 kg/year of processed tomato and 500 - 2 000 Kg/year of processed onion. The volume of production is less significant in North Benin (100-200 Kg for Tomato, and less than 60 Kg for chilli pepper). The operation cost varied depending on the processed vegetables. For example, the operation costs were estimated to about 415 FCFA per Kg of mashed tomato, 1 887 FCFA per Kg of seasoned chilli pepper powder, 980 FCFA per Kg of mashed onion. The most profitable processed vegetables were Carrot juice (2 480 FCFA per Kg), seasoned chilli pepper powder (1 185 FCFA per Kg), mashed onion (520 FCFA per Kg). The less profitable processed vegetables were dried tomato (147 FCFA per Kg) and dried chilli pepper (35 FCFA per Kg).

Processors indicated specific preferences for vegetables. For tomato, processors indicated preferences for improved tomato varieties which are fleshy with less water content and less acid. However, In South Benin, CEVADEL, a local start-up specialized in processing of local vegetable, prefers *"Tounvi"* a local tomato variety, less fleshy but with a very attractive red colour — red colour is well appreciated by sauces. Although *"Akinkonkouin"* (another local tomato variety) is less red, it was well appreciated by processors for its fleshiness and consistency. For chilli pepper and habanero pepper, processors indicated preferences for local variety from Malanville which is fleshy, big, red and less spicy —well appreciated as table pepper. The startup CHIC FOOD which exports seasoned chilli pepper to Europe, USA, RDC and Equatorial Guinea, prefers this local variety of chilli. For onion, processors indicated preference for the onion from Malanville, which is bigger, consistent and of white color. For carrot,

the improved variety “Season cross” is preferred by processers due to its big size and attractive orange colour.

While tomatoes (July to September) and onions (March to April) are processed during one processing cycle in a year, chilli peppers and carrots are processed almost all year round. The differences between processing cycles depend on the quantity of raw materials purchased per period of availability. For each vegetable, Table 7 shows the price of a standard quantity of raw material, cost of processing operations, selling price of obtained products, and yield of finished product compared to raw material. Vegetable processors experience low to moderate post-processing losses, caused mainly by fermentation, fungal growth with poor bottle cleaning, lack of sterilisation, bottle breakage during sterilisation and storage, and loss of colour and quality after prolonged exposure to the sun. The only equipment used by processor is the mill, which is either bought or rented. Renting costs FCFA 30 000 to 50 000 for three months and a small new one costs about FCFA 245 000. Access to credit among them is low, probably due to higher interest rates and shorter differed periods.

Table 7

Purchase price of a unit of raw material, processing cost, and selling price

Vegetable	Area	Purchase price of a unit of raw material	Cost of processing the same unit of raw material	Selling price of obtained products	Quantity (kg) of raw materials needed for 1 kg of processed product
Tomato	South	With price fluctuations a basket of 10 kg costs on average 1 250 FCFA	2 875 FCFA (gas, packaging, transport, manpower)	5.5 kg of mashed tomato produced sold at 6 000 FCFA	1.81 kg of fresh tomatoes needed for 1 kg of mashed tomato
	North	With price fluctuations a basket of 40 kg costs on average 5 500 FCFA	Processing into dried tomatoes does not require special ingredients. The labour is mainly family based and therefore free	8 kg of dried tomatoes sold at 7 000 FCFA	5 kg of fresh tomatoes needed for 1 kg of dried tomatoes
Chilli pepper	South	With price fluctuations a bag of 100 kg costs on average 27 500 FCFA	104 600 FCFA (ingredients, packaging, transport, manpower)	23.6 kg of flavoured powder sold at 215 000 FCFA	4.23 kg of fresh pepper needed for 1 kg of flavoured powder
	North	With price fluctuations a bag of 100 kg costs on average 25 000 FCFA	5 000 FCFA for mill	30 kg of simple powder sold at 35 000 FCFA	3.30 kg of fresh pepper needed for 1kg of simple powder
Onion	South	With price fluctuations a bag of 100 kg costs in average 40 000 FCFA	58 000 FCFA (gas/ charcoal, packaging, manpower)	83 kg of onion puree sold at 124 500 FCFA	1.20 kg of fresh onion needed for 1 kg of onion puree
Carrot	South	With price fluctuations 10 kg of carrot costs in average 4 500 FCFA	42 700 FCFA (packaging, charcoal, manpower, transport)	79.2 liters of carrot juice, sold at 65 000 FCFA	0.13 kg of carrot needed for 1 liter of carrot juice

Availability and marketing of processed products

Throughout the year, the availability of processed products varies by vegetable and region (Table 8). Generally, processed products are available during a specific period, except for carrot products which are available throughout the year. The periods of low availability of processed products correspond to those of high availability of the raw materials. In these periods, processors experience a peak in their processing cycles while consumers buy fresh vegetables because they are cheaper. Inversely, periods of high availability of processed products correspond to those of low availability of raw materials that are expensive. It is important to note that the demand for processed products has increased over the last five years due to the growing number of middle-class consumers but also more vegetable supply.

Table 8

Periods of availability of processed products of vegetables

Vegetable	Months of high availability		Months of low availability	
	South	North	South	North
Tomato	October to June	December to February	July to September	March to November
Chilli pepper	May to December	October to April	January to April	May to September
Onion	May to December	-	March to April	-
Carrot	Through the year	-	Through the year	-

More than 50% of the processed products are purchased by households, followed by local retailers and supermarkets and restaurants. Specifically, for carrots, processed products are purchased by households (50%) and restaurants (50%). In the South, and contrary to the north, there are pre-orders and deposit-sales between processors and local retailers, supermarkets, and restaurants. However, these contracts are sometimes difficult for the processors to comply with, especially when there are shortages of raw materials.

Constraints

Processors encountered some constraints during their activities. First, there is the *lack of quantity and quality supply and modern equipment* to process vegetables. Due to the unstable production volumes and the various varieties in the market, processors face a lack of quantity and quality supply of vegetables. Next, vegetable processing is still developing and artisanal, therefore, makes it difficult to process huge quantities. Among equipment needed, there are grinders, measuring scale for weighing bags, oven to dry washed raw materials, materials for automatic bottling and packaging, and for pasteurization. Second, there is the *difficulty to access to credit* which, limits the capacity of processors to increase the processing volumes. Third, there is a *low level of technical skills* among processors. Indeed, most of them engage in this activity without training, thereby, struggle to handle the whole processing cycle well. Last, they have a *small market share* that impedes their willingness to grow their businesses.

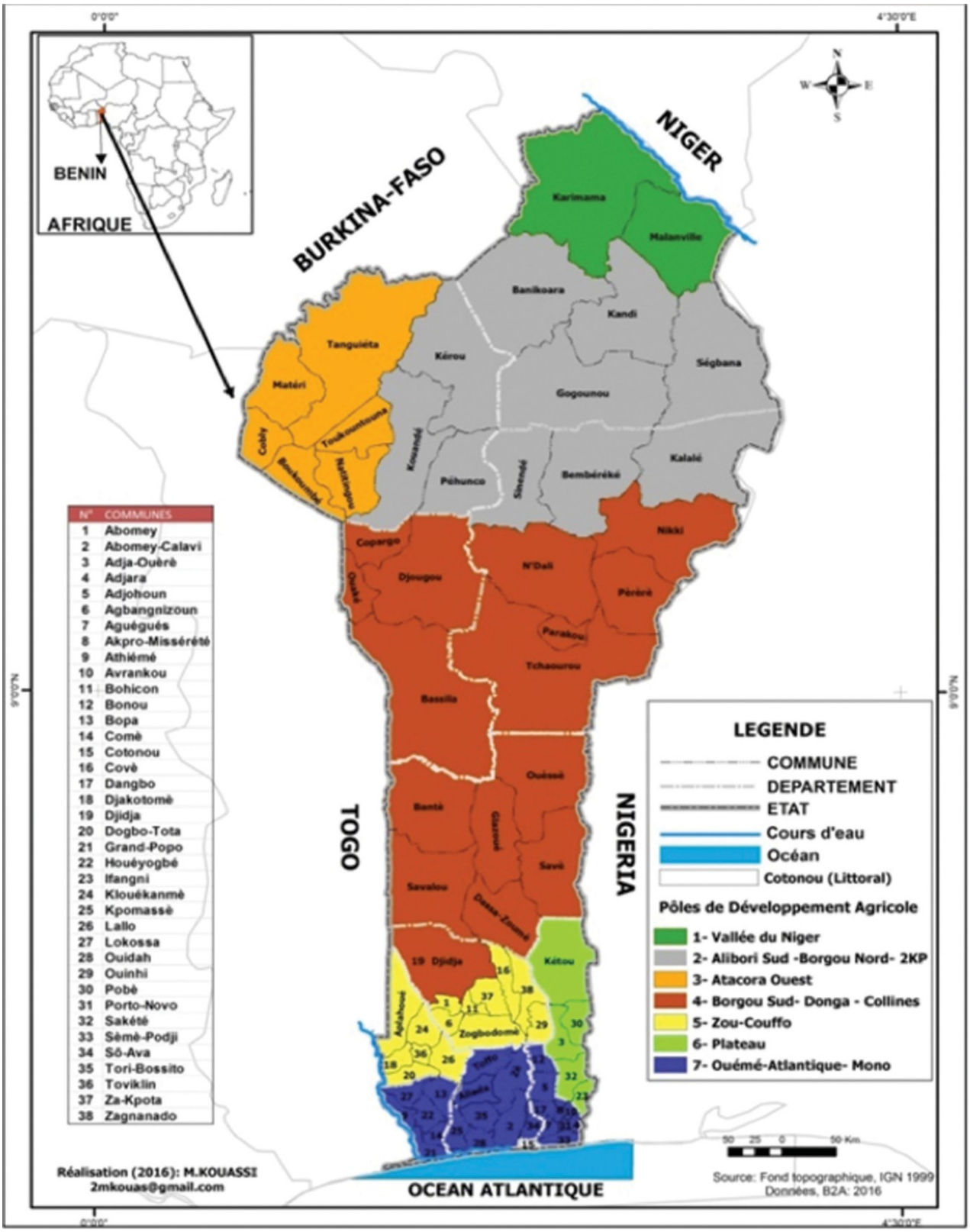
3.2.5 Production of vegetables →

Agroecological conditions and vegetable cropping systems in Benin

Benin is subdivided into eight agroecological zones according to climatic and agro-pedological parameters, cropping systems, population density, and vegetation cover. Based on this, the government divided the country into seven agricultural development poles (Figure 6) to support relevant crops that have high potential for the economy and food security. Although, vegetables production is generally practiced across the country, the agricultural development poles 1 (Malanville, Karimama) and 7 (Oueme, Atlantique, Littoral, Mono) present the best agricultural conditions for the development of the vegetables sector and are considered as priority areas for policy interventions in the sector. Among the vegetables targeted by the present study, tomato, onion and chilli are among the priority in the agricultural development pole 1, while all targeted vegetable are priority in the agricultural development pole 7. In addition, beyond the relevance of other high-value crops, the agricultural development zones 3 (west Atacora), 4 (Collines) and 6 (Plateau) also present good potential for vegetables production.

Figure 6

Map of the agricultural development poles (Source: PSDSA/PNIASAN 2017)



The vegetable production in Benin (both North and South) occurs during both dry and rainy periods, with ecological conditions (i.e. soil, temperature, rainfall, wind, and evapotranspiration) varying per period, and from South to North.

Table 9

Graphical description of agricultural seasons (1957 to 2017) in Benin

		Jan	Feb	Mar	Apr	May	Jun	July	Aou	Sept	Oct	Nov	Dec
Dry season	North												
	South												
Rainy season	North												
	South												
Legend	Dry season							Rainy season					

In South Benin (mainly coastal zone), soils are mineral, sandy, and thus leachable. Vegetables are therefore produced in raised garden bed. Such soils conditions are suitable for bulb (onion) and tuber (carrot). From March to November, there are two rainy seasons, a long one (March/April to June) and a short one (mid-September to mid-November) (Table 9). Tomato and peppers benefit from adequate rainfall (low evapotranspiration), moderate winds and are abundantly produced especially during the long rainy season. From November to January, rainfall is low and there is a high evapotranspiration. During this period, vegetable production is only possible with irrigation, or in shallow (December-February) (Table 10).

In North Benin, soils are mainly ferruginous and less sandy. Vegetables are produced in land boxes. The period of May to October corresponds to the unique rainy season with important rainfall (Table 9). During this period, tomato and peppers are abundantly produced between July and October. The period of November to March corresponds to the unique dry season which offer adequate condition for the production of tomato, pepper, and onion but under irrigation (Table 11).

Table 10

Vegetable production seasons in South Benin

		Jan	Feb	Mar	Apr	May	Jun	July	Aou	Sept	Oct	Nov	Dec
Tomato	Rainfed												
	Irrigated												
	Recessional												
Peppers	Rainfed												
	Irrigated												
	Recessional												
Onion	Irrigated												
Carrot	Irrigated												
Legend		Production period						No production					

Table 11

Vegetable production seasons in North Benin

		Jan	Feb	Mar	Apr	May	Jun	July	Aou	Sept	Oct	Nov	Dec
Tomato	Rained							■	■	■	■		
	Irrigated	■	■	■								■	■
Peppers	Rainfed							■	■	■	■		
	Irrigated	■	■	■								■	■
Onion	Irrigated	■	■	■								■	■
Legend		■						No production					

In terms of cropping systems, four main systems are identified across the country: (i) Rainfed system, (ii) Irrigated system, (iii) recessional system and (iv) Soilless system. The cropping systems perform differently depending on the zone (Table 12). In both zones (south and north), the irrigated vegetable production is the dominated and main cropping system and is observed in the Extreme North of Benin (Malanville and Karimama) and in the departments of Atlantic, littoral, Mono, Ouèmè in the South Benin. In the North, there is mainly furrow irrigation system (Photo 4) while in the South many techniques are used including sprinkler irrigation, drip irrigation, etc. (Photo 5). The rainfed vegetable production is mostly observed in the North Benin and less in the South zone. The recessional vegetable production is mainly observed in the South Benin (Oueme Valley) and in a lesser extent in Alibori river catchment. Northern vegetable farmers indicated that it is not possible to practice recessional vegetable system in Niger valley due to a phenomenon of black water upwelling, locally known as “Eau noire”. The soilless vegetable production system is observed only in the South Benin (Cotonou), and also in the middle Benin (Save). Tomato, peppers (both habanero and chilli) and onion are produced in all the identified cropping systems while carrot is produced only in rainfed and irrigated systems.

Photo 4

Irrigated vegetable production systems (furrow irrigation) in North Benin

Table 12

Vegetable cropping systems in Benin

		Prevalence	Location	Vegetables
Rainfed system	North	20%	Banikoara, Kandi, Gogounou, Segbana	Tomato, peppers
	South	<4%	Adjohoun, Dangbo, Bonou, Allada, etc.	Tomato, peppers, Onion, Carrot
Irrigated system	North	70%	Malanville, Karimama	Tomato, peppers, Onion
	South	90%	Cotonou, Seme, Avrankou, Adjarra, Grand Popo, Ouidah, Kpomasse, Togbin	Tomate, peppers, Onion, Carrot
Recessional system	North	10%	Karimama, around Alibori river catchment	
	South	5%	Adjohoun, Dangbo, Bonou	Tomato, peppers
Soilless system	North	-		
	South	<1%	Cotonou	Tomato, peppers, Onion

Recessional agriculture is a form of agricultural cultivation that takes place on a floodplain.

Photo 5

Irrigated vegetable production systems in South Benin

Trends in vegetable production and cultivated lands

Based on official statistics (DSA/MAEP 2021), the production for the selected vegetable (Tomato, Chilli pepper, Habanero pepper, onion, and carrot) is unstable (Table 13). During the past years, the production of Tomato showed a slight annual increase of 3,5% and reached 360 250 Tons in 2020. The production of pepper (both chilli and habanero) also slightly increased with an annual rate of 3.4%, attained a record of 102 136 in 2019 tons before dropping to 86 830 tons in 2020. In opposite the production of onion constantly decreased the last four year and reached 66 540 tons in 2020, its lowest level since 2016-2017 agricultural campaign. A similar trend was observed for carrot for which the production decreased the last three and reached 13 313 tons. The decline in production for onion was mainly due to pest pressure, the persistent use of traditional and unsuitable cultivation techniques, and the lack of support to producers, resulting in low yields (Mensah et al., 2019[10]). According to the vegetables stakeholders, the overall decline or stagnation of the vegetable production in 2020 is also due not only to adverse effects of climate changes (Extreme heat and scarce rains) but also and most importantly to agricultural market shocks due to the closure of Benin-Nigeria borders and COVID-19 pandemic. As depicted by official statistics, vegetables cultivated lands dropped in 2020 for all the five selected vegetables (except for Carrot), respectively by 16.3% for tomato, 7.7% for pepper (both chilli and habanero), 17.5% for onion (Table 14).

Table 13

Annual production of the selected number of vegetables over the last five years

Agricultural campaign	Production in tons			
	Tomato	Pepper (Chilli and Habanero)	Onion	Carrot
2015-2016	303 893	75 722	71 147	11 356
2016-2017	335 412	88 268	81 177	14 356
2017-2018	339 902	92 071	69 901	15 603
2018-2019	360 195	102 136	69 540	11 937
2019-2020	360 250	86 830	66 904	13 313

Source: DSA/MAEP, 2020

[10] Mensah A. C. G., Sikirou R., Assogba Komlan F., Yarou B. B., Midingoyi S-K., Honfoga J., Dossoumou M-E., Kpéra G. Nathalie et Djinadou A. K. Alice. (2019). Mieux produire l'oignon au Bénin. Référentiel Technico-Economique (RTE). MAEP/INRAB/FIDA/ProCar/PADMAR/World Vegetable Center/Bénin. Dépôt légal N° : 11555, du 26/08/2019, Bibliothèque Nationale (BN) du Bénin, 3ème trimestre. ISBN : 978-99982-53-15-5.

Table 14

Annual vegetable cultivated lands of the selected vegetables over the last five years

Agricultural campaign	Land in ha			
	Tomato	Pepper (Chilli and Habanero)	Onion	Carrot
2015-2016	39'030	25'861	4'156	717
2016-2017	40'177	27'729	4'453	812
2017-2018	41'339	27'923	3'751	866
2018-2019	47'588	30'324	4'798	646
2019-2020	39'833	27'981	3'959	760

Source: DSA/MAEP, 2020

About vegetable farmers/gardeners and their profile

According to the National Federation of gardener Organizations of Benin (FeNOMA-Benin), as for March 2021, there was about 63 000 officially registered vegetable farmers/gardeners in Benin, of which 48% (30 240) are women. These farmers/gardeners are located in 11 departments across the country, are organized into cooperatives, communal and regional unions which are affiliated to FeNOMA-Benin. As enrolment is still ongoing, the total number is expected to significantly evolve in the coming months. According to key informants interviewed during this study, this official statistic of the total number of farmers/gardeners is largely underreported. They projected that the total number of farmers/gardeners will approach around 100 000 persons.

In general, and regardless of the zone (North or South Benin), vegetable farmers and gardeners are mainly young men, but with also a prominent representation of adult and old persons (Table 15). Although, this is less than the figures of FeNOMA, our investigation showed that women are less represented in vegetable production, especially in the North Benin where vegetable farmers/gardeners were initially involved in other agricultural activities. In the South Benin, and especially in urban areas (Calavi, Cotonou, Porto-Novo, Grand Popo), farmers/gardeners are from various professional background including agriculture, taximen, fishermen, trade, public service retirees, etc.

Table 15

Profile of vegetable farmers/gardeners in Benin

Main characteristics		North	South
Age category	Young (<35)	4'156	717
	Adult (35-65)	4'453	812
	Old (<65)	3'751	866
Gender	Male	4'798	646
	Female	3'959	760
Professional activities	On-farm activities		
	Off-farm activities		
Cultivated area per farmer	Largest areas per farmer/gardener		
	Smallest areas per farmer/gardener		
	Average areas per farmer/gardener		

*The greatest vegetable farmer in Benin (Mr. Adjeoda) cultivated in more than 10 ha in Grand-Popo

The modes of access to land are different depending on the location of farmers/gardeners (Table 16). In the North Benin, the dominant mode of access to land is inheritance, where almost all farmers/gardeners in this zone inherited cultivated land. Generally, men inherit more land than women. The dominated modes of access to land especially in Seme-Kodji, Calavi and Cotonou were "free loan for use"[11], and rental (mostly for other districts in Atlantic, Oueme and Plateau). In the South Benin, a hectare is rented for about 100 000 - 150 000 FCFA, and costs 400 000 – 500 000 FCFA in rural areas for purchase. According to the vegetable farmers/gardeners, inheritance as mode of access to land is increasingly rare in South Benin. Borrowing is the dominant mode of access to land for women, with 32% of women borrowing land compared to 20.5% of men (ACCD, 2019[12])

Table 16

Different modes of access to land for vegetable production in Benin

Access modes to land	North	South	Remarks
Inheritance	90%	-	
Rental	6%	30%	About 100 000- 150 000 FCFA per ha per year
Sharecropping	-	10%	Observed in Seme-Kpodji, Cotonou and Atlantic department
Purchase	4%	10%	400 000 – 500 000 FCFA per ha in the South
Free loan for use	-	50%	Abomey-Calavi, Seme-Kpodji, Cotonou

Rental or loan contracts are established verbally, which is a source of frequent conflicts among small market gardeners. Some gardeners also encountered difficulties because they exploit public domains without any deed of endowment. This situation of land insecurity does create an unstable environment that is hardly conducive to investment or the sustainable development of the vegetables sector.

Performance of vegetable production

In terms of yield, there is also an unstable trend over the five years (Table 17). The average yields are 8 194 Kg/ha, 3 176 Kg/ha, 17 075 Kg/ha and 17 509 Kg/ha, respectively for Tomato, Pepper, Onion and Carrot. Tomato yield declined from 2017 to 2019, before it reached its best record of 9 044 Kg/ha in 2020. Pepper and Carrot yields increased steadily from 2015 to 2019 and declined in 2020. Onion yield dropped drastically in 2019 by 22.22% before increasing again in 2020 by 16.57%.

Table 17

Annual yield of the selected vegetables over the last five years

Agricultural campaign	Yield (Kg per ha)			
	Tomato	Pepper	Onion	Carrot
2015-2016	7'786	2'928	17'120	15'847
2016-2017	8'348	3'183	18'228	17'680
2017-2018	8'222	3'297	18'635	18'017
2018-2019	7'569	3'368	14'494	18'485
2019-2020	9'044	3'103	16'898	17'515

Source: DSA/MAEP, 2020

Production costs vary with vegetables, varieties, cropping systems and zones (Table 19). The average production costs of all vegetables (in irrigated systems) are higher in South Benin compared to North Benin. In soilless system, the production costs for Tomato, pepper (Chilli and Habanero) were two times higher in comparison to those from irrigated systems. The revenues from vegetable production also varied significantly depending on the period of the year as selling prices were highly volatile (Table 18).

Table 18

Variation of selling price of vegetables across the year

		Low availability (FCFA/Kg)	Medium availability (FCFA/Kg)	High availability (FCFA/Kg)
Tomato	South	200-335	50-70	15-20
	North	200-235	100-125	15-250
Chili pepper	South	720-800	500-550	360-400
	North	250-350	150-170	120-140
Habanero pepper	South	350-400	170-200	120-180
	North	200-225	140-150	60-70
Onion	South	400-450	200-250	50-60
	North	400-450	200-250	50-60
Carrot	South	800-900	400-500	250-300

Below are some estimations of revenues and profits based on median selling prices (Table 19). Within irrigated systems, vegetables revenues are higher for chilli pepper, carrot and onion in South Benin, onion, and chilli pepper in North Benin. The best profits were realised with carrot and chilli pepper in South Benin, and with onion and carrot in North Benin. In general vegetables revenues in soilless systems were higher compared to irrigated systems. However, soilless systems generated more profits only for Habanero and Tomato which were sold through organic marketing channels, with better prices. Although, local tomato varieties seem more profitable than improved varieties in the table, we suspect a confusion within data collected because farmers generally agreed that improved tomato varieties were more performant than local tomato varieties.

Table 19

Production costs, revenues, and profits for selected vegetables

		Production cost (FCFA/Kg)		Gross Revenue (FCFA/Kg)		Gross Profit (FCFA/Kg)	
	Variety/cropping systems	North	South	North	South	North	South
Tomato	Local variety/Irrigated	25	31	125	167	100	136
	Improved variety/Irrigated	55	61	125	167	70	106
	Local or improved/Soilless system	-	244	-	400	0	156
Chilli Pepper	Local or improved/Irrigated	125	189	235	580	110	391
	Local or improved/ Soilless system		412		600	0	188
Habaner pepper	Local or improved/Irrigated	125	189	143	260	18	71
	Local or improved/Soilless system	-	412	-	500	0	88
Onion	Local or improved/Irrigated	29	91	250	250	221	159
Carrot	Local or improved/Irrigated	23	29	200	575	177	546

Gross profit does not include land costs and other overheads are not included, but labour costs are included in the calculation.

Constraints

Vegetable farmers/gardeners reported on various elements as main constraints hampering the conducive conduct of their activities. These constraints were mainly related to the quality seeds and performance of hybrid varieties, postharvest loss, water management, pest management, fertilizers (availability, price), and the workface.

The availability and access to high quality seeds is, therefore, a major issue in the sector. Many producers are still exposed to uncertified and low-quality seeds, making some of them lean towards importing seeds from neighbouring countries such as Ghana. Producers also indicated poor quality for certified seeds supplied including from reputable firms installed in Benin. Sometimes, they experienced very low germinative capacity from so-called hybrid/improved varieties, due to poor storage conditions (temperatures, packs exposed to sunlight) that affect seed germination. Apart from the quality, vegetable producers indicated some hybrid varieties especially for tomato and habanero seeds as not suitable for local ecological conditions. For example, none of the various hybrid varieties of tomato supports extreme heat, and then cannot be produced along the year. According to the FeNOMA, Benin will significantly improve its national production of tomato. They have heat tolerant varieties. Similarly, they indicated that the available hybrid varieties for Habanero (Tchika and ATDA) are not suitable to local ecological conditions, producing more flowers and less fruits.

Postharvest loss is another major challenge of producers. Vegetable producers were very concerned especially for tomato and habanero for which postharvest losses were important — up to 30% for tomato and 15% for habanero pepper. The case of tomato is extremely alarming. During the period of high availability of tomato, the price dropped significantly, and large unsold volumes are lost. Apart from some traditional and elementary techniques (burring tomato with a mix of ash and sand), there is no efficient and systematic postharvest strategies and existing processing consumed only a small volume of the production.

The vegetable producers also complain about water management. The issue was mainly about equipment and energy. For example, in the North Benin, the drillings are very deep and large pumps are needed to bring up the water, thus consuming a lot of energy.

The vegetable producers also face difficulties related to the availability, price and specificity of chemical fertilizers and crop health products, forcing them to resort to informal sources (especially from Nigeria) or to use cotton fertilisers and crop protection products, potentially harming consumers' health. Producers experienced regular shortage of these inputs and inflation on their prices. Regarding organic inputs, producers often resort to livestock farmers for fertilizers (e.g., poultry droppings, cow dung and compost). They indicated their interests for more organic fertilizers but at affordable prices. Next, despite the presence of equipment suppliers, there is a gap in specific materials needed for vegetable production and in modern equipment adapted to local conditions.

Regarding finance, there is still a weak engagement of finance institutions in agriculture in general. The situation for the vegetables sector is worse as financial institutions consider this sector riskier than staple foods due to its high perishability and climate hazards. Next, loans conditions are difficult for borrowers as there is no deferred period and the need to have a high cofounding.

Finally, producers especially in South Benin reported on difficulties related to labour workforce which is unskilled and not always available.

3.2.6 Inputs, equipment, finance, and services →

The vegetables sector is supported by inputs suppliers (seeds, fertilizers, plant heath products), equipment suppliers, services providers, and finance institutions.

Seeds, fertilisers, and plant health products

Vegetable farmers/gardeners used various seeds for the selected vegetables including local and hybrid/improved varieties (Table 20). For tomato, local seeds are cheaper but less performant. Hybrid/improved seeds are generally more expensive, lead to higher production costs but were appreciated by producers for their high yields. For example, 20g of Tounvi (a local tomato variety) was about 2 500 FCFA while a same weight of Torgal (hybrid/improved variety) was about 11 600 FCFA. However, consumers and processors prefer local varieties for the taste and low prices, respectively. For chilli and habanero pepper, improved seeds are more expensive and perform better than local seeds. However, for habanero pepper, improved seeds give sometimes a lot of flowers and less fruits, thereby, perform

less in this case. For onion, *Violet de Galmi* (improved seed) is the most preferred variety as it is less perishable and tastier. For carrot, *All season* (improved variety) is the most preferred variety for its high yields and taste.

Table 20

Vegetable varieties cultivated in Benin

	Vegetable	Local name/Commercial name
Tomato	local	Aklinkonkouin, Tounvi, Kekefo, Ouaga
	Hybrid/improved	Buffalo, Torgal, Tropinex, Petomex, Cobra, Mongal, Bronduille, Sonafel, Dogarawa, Padma
Chilli pepper	Local	Savalou/danme-takin, Mahiri, Afoundja, Tchobo
	Hybrid/improved	Forever, Demon, Bec d'oiseau
Habanero pepper	Local	Djimbolo, Zorawa, Aklataki, Gbotaki
	Hybrid/Improved	Tchika, ATDA
Onion	Local	Rouge de Tana
	Hybrid/Improved	Violet de Galmi, Violet de Damani, Charlotte
Carrot	Hybrid/Improved	Japon Cross, All season cross, Amazonia, Vilborin

Seeds' suppliers are made of local and foreign enterprises. They either supply one product (seeds) or supply a combination of products (seeds, equipment) to the market. Concerning seeds supply, they are organised such that there are seed producers and seed distributors and/or both. For hybrid/improved seeds, we found two main foreign (Dutch) seed companies that conduct laboratory research to improve and produce varieties for sales through distributors. There is East-West Seeds (since 2010) and Rijk Zwaan (since 2017) who distribute their varieties through 'A la ferme géniale Sarl', and Songhai Benin, and through Holland Green Tech, respectively. Besides, there are two main Beninese seed producers and distributors: Benin Semences and Accueil Paysan. Benin Semences, member of the international group Novalliance, produces and distributes local and improved seeds from the group: Technisem, Tropica, Jardinova and Jarditropic. Accueil Paysan also produces some local seeds and distributes a large variety of imported seeds. Beyond these well-established seeds suppliers, there are many small enterprises or lead farmers who produce local varieties and buy from the previous suppliers for retails. Examples are Coopérative Jardin pour tous, SEBA'3D, Mon Secret, Bénin Agri Vert,. All these suppliers have their renewable three-year formal agreement for certified seed production and distribution from the Plant Protection Department of the Ministry of Agriculture. However, there are many informal players that supply producers with uncertified seeds, creating several production problems to producers.

In the segment of fertilizers and plant protection products, the main player is a Beninese enterprise (SODECO). SODECO, formerly owned by the current President of Benin, is mostly specialized in cotton industry and has a sort of monopoly in this business area, though the entry is allowed to other private enterprises. Therefore, most of the products are not specific to vegetables, leaving producers mainly with cotton fertilizers (NPK and Urea). Furthermore, there is Accueil Paysan and BioPhyto that provide producers with specific chemical and organic vegetables fertilizers and crop protection products. However, there are many informal suppliers who import prohibited products in the country, showing that much remains to be done if the industry is open for business entry.

Concerning fertilizers, vegetable farmers used NKP and urea, originally cotton based fertilizers. They pay the NKP bag (50kg) for about 13 300 – 15 000 FCFA, and the urea bag (50Kg) about 13950 – 20 000 FCFA. They are supplied by SODECO but also wholesalers receiving fertilizers from Nigeria. According to vegetable farmers, NPK from Nigeria is of bad quality. However, urea from Nigeria is well appreciated. Generally,

there are frequent shortages of urea in July and August in North Benin, and the supply from Nigeria remains the solution. As for weedkiller and plant health products, vegetable farmers used both approved from SODECO and non-approved products from wholesalers receiving products from Nigeria and Ghana.

Equipment

Specific vegetables production equipment is generally available on the market. Most available materials are for small-scale gardens and are mainly imported from China, India, Nigeria, and Ghana. Importers source their materials from these countries mainly because they are cheaper. For instance, beyond seeds, Acceuil Paysan supplies small materials such as sprayers, watering cans, rakes, hoes, protective clothing, and other small materials. However, the spectrum of available materials is limited in the country. For instance, specific materials such as plastic mulch, nursery materials, etc. miss in the available products. Since 2019, there have been newcomers (DIVATEC and Holland Green Tech) who aim to demonstrate the potential of high quality and sophisticated materials but adapted to local conditions. DIVATEC, French enterprise, developed *Les Primeurs Du Bénin* as an innovative and modern farm that uses advanced equipment to improve the productivity, with the goal to sell or rent materials to Beninese producers. Holland Green Tech (HGT), Dutch enterprise, proposes advanced irrigation systems and greenhouses to improve the productivity of farms. HGT does so with Flo-Grow through a participatory project named HortiBenin that engages lead farmers in the use of quality seeds and equipment to boost their productivity, thereby, their income.

Finance

Financing the agriculture sector in general is a major issue in the country as the sector is said to be too risky for finance institutions due to natural hazards. This situation is similar for the vegetables sector although there has been an interest from finance institutions these recent years. For instance, since its creation in 2006, it was only in 2012 that ALIDé started its investment in the vegetables sector. A similar situation was indicated for the other financing institutions such as CLCAM, CAVECA, PEBCO, and BETHESDA. They generally provide loans to producers and processors, but amounts are generally low and require a high matching funds from borrowers. The monthly interest rate is 1% with around 10-15% of guarantee in cash and short grace period. For an amount exceeding FCFA 5 000 000, the loan is systematically insured; yet the access is low. Furthermore, despite the guarantee fund provided by the government through FNDA to finance institutions, there is still a low penetration of loans among producers, impeding the development of the sector. To address this challenge, for example, ACMA2 project set up an innovative mechanism (‘warrantage’) to help farmers access credit from financial institutions by securing their harvests for sale in rewarding periods. Such innovation would be difficult for vegetables as these are highly perishable.

Agricultural advisory services

The advisory services are mainly provided by the government extension services. In addition, there are various national and international NGOs, consultancies, and governmental programmes that provide specific extension services to producers and processors based on the purposes of the programmes and targeted crops/vegetables. Furthermore, spontaneous trainings, upon paid requests, are given by the research institution GBIOS and other private organizations such as Songhai centre and Africa Green Corporation. However, overall, there is a weak coverage of agricultural extension services with low level of satisfaction of gardeners. In 2019, agricultural stakeholders nationwide were not very satisfied with extension services (MAEP, 2020[13]). Indeed, 19% were satisfied for agricultural advisory support, 17% for farm management advice, 13% for specialist technical advice and only 4% for market access advice. Regarding the gender, men were generally more satisfied than women except for the access to credits for which women were more satisfied.

[13] MAEP (2020). Rapport de Performances du Secteur Agricole, Gestion 2019.

3.3 Youth and gender dynamics in the vegetables sector →

The vegetables sector is mainly composed of producers, processors, and traders. Discussions with producers, processors, and traders/ exporters indicated that men are most active in the production segment while, women are more dominant in the processing and marketing segments. According to FENOMA, 48% of the 63 000 producers are women and there is a stunning number of youth among producers, showing an increasing participation of women and youth at the production level. However, women and youth face much more constraints than men adults, in accessing fertile land, working materials, credit, and decision-making positions within producer organizations. Women also face some socio-cultural and religious barriers that impede them to inherit land, have access to quality land, and carry out productive activities; some cultural norms prefer women to focus on domestic work.

In our study, we found that women, regardless of the zone, were mostly involved in the production of tomato, onion, and carrot while men were involved in the production of pepper (both chilli and habanero). Box 1 below shows a case of a woman living in rural area and producing vegetables. Young men were active in the production of all vegetables. The specialisation of women in producing tomato, onion and carrot was justified by the short agronomic cycle of these crops, the easiness of the production and the opportunities of processing in case of sale shortages.

Among women and youth, there is a growing number of educated people who probably started this activity because they could not find other job opportunities. For instance, a recent study[14] of ACED in 2019 within urban gardeners of Cotonou and Porto-Novo showed that youth (less than 35 years old) comprised 34% of gardeners and were mostly (67%) educated. The study also found that gardeners largely cover their basic needs; hence, a nice indication to support the vegetables sector to encourage more women and youth to enter the industry and reduce unemployment in Benin. The findings also imply that as more educated people are entering the sector, it is high likely that they easily get capacitated and quickly adopt improved farming technologies (quality seeds, fertilizer, equipment) to bring the vegetables sector to the next level.

This study also showed that women and youth dominate (more than 80 %) the processing and marketing activities in the vegetables sector. This is corroborated by a recent national study of Actions-Conseils pour le Développement Durable (2019[15]) which found that 98% of processors and 83% of marketers were women. The study also found that most stakeholders of the vegetables sector are 30 to 40 years old on average, confirming the growing presence of youth. Box 2 below shows the case of a woman living in urban area and processing vegetables.

[14] Houessou, D., F. Thoto, B. Sonneveld, A. Aoudji, S. Dossou, B. Agbandou (2019) Urban agriculture in Benin: How can policy support gardeners? Research report. ACWFS/ACED/FSA-UAC.

[15] Actions-Conseils pour le Développement Durable (2019). Étude d'identification et de caractérisation des flux des produits maraîcher entre le Bénin, le Togo, le Nigéria, le Burkina et le Niger.

Box 1 - Example of a woman living in a rural area and producing vegetables

My name is Rosalie ADANHOU and I live in the commune of Sô-Ava. I am a producer of vegetables including tomatoes and peppers. I chose to produce vegetables because of the availability of water in my area and the profitability of the activity despite some difficulties that are encountered during the production. I recommend this activity to other women because, despite the difficulties, it generates income for women and contributes to their empowerment. I have no difficulties with the quality of the seeds as I generally use local varieties of good quality. In my own experience and that of other women, local seeds are very well adapted to our ecological conditions. To fertilise the soil, I only use organic fertilisers, especially compost. In fact, I have never used chemical fertilisers because for me the abundance of water in my area already constitutes a form of fertilisation in addition to organic fertiliser. Nevertheless, sometimes I have difficulties in accessing organic fertiliser because of the lack of financial means to obtain it. This is a general difficulty faced by women market gardeners. During production, I remark poor health of vegetables due to caterpillars. In such cases, we do not get any help from the agricultural extension services, and we use some chemicals from Nigeria. Like my colleagues, I do not use any modern equipment for vegetable production except for the usual basic tools (cutters, hoes, watering cans etc.) which were given to us by an NGO working in the commune of Sô-Ava. I face post-harvest losses which are due, in my opinion, to the perishability of vegetables and their weak conservation. We have no way of addressing this problem and we have also received no support from the extension services, so we just suffer from it. In the past, the government extension services used to lend us money, but since they stopped, we have turned to PADME though, it was difficult to meet conditions. I use transport services, usually car and motorbike taxis, just to transport my products to the markets in Pahou, Dantokpa and Akassato. I do not use delivery services. I have access to market because my products are sold at the roadside, but also in the different markets I mentioned above. However, we must pay for tickets to access the market and sell our products. I don't have access to any information about the markets other than what I get from other women producing vegetables. Sometimes, it is hard to sell my products from organic production , especially during periods when vegetables from Malanville and Burkina Faso are on the market, because consumers are attracted by vegetables with big size, usually produced with chemical fertiliser. In my opinion, to strengthen women's capacities and to empower them in the vegetable production activity, we need support in terms of micro-financing and the creation of markets or even a special vegetable outlet to facilitate the sale of our products.

Box 2 - Example of a woman living in urban area and processing vegetables

My name is Francisca Audace AKAKPO, I am a food processor living in Porto-Novo. I mainly process red pepper into flavoured pepper powder. I chose this vegetable because its powder is very appreciated and consumed by households. It allows us to flavour our various meals without using chemical broths. I recommend this activity to women who want to start a business because it is profitable and contributes to women empowerment. I have already recommended this activity to other women, as it is promising. However, it is important to have a minimum level of education to be comfortable with accounting and management, but also to understand quality control. However, I have difficulties in accessing and sourcing raw materials as I have not yet been able to have direct contact with wholesalers due to my financial inability to buy a large quantity, but also the price of raw materials is increasing regularly. I am therefore obliged to buy small quantities to operate. I have not adequate equipment and materials for processing and packaging my processed products due to lack of funding. For packaging, I buy from retailers, which is more expensive. Despite all these difficulties, I find the activity profitable, and it would be even more if I could get financing to address these difficulties.I do not have a secured market share for my products but I always try to promote the products. To get my products to flow quickly, I deliver them myself because customers don't like to pay for shipping and delivery. The delivery is done in the cities of Porto-Novo, Cotonou and Abomey-Calavi, which reduces a bit the profitability. I don't have access to microfinance and insurance services because I don't have a guarantee nor a fixed location for my enterprise. I work at home with my small savings or small loans from my relatives to run my business. The issues on which I think we (small processors) need support are training on processing techniques, digital marketing, and financing.

4.

Sector-wide findings, sector bottlenecks, and business opportunities

4.1 Sector-wide findings →

In this chapter we analyse the findings regarding the whole sector and provide the main conclusions and business opportunities. Four of the most interesting business opportunities will be further elaborated on, for which we will also provide funding opportunities. The main findings that we distilled from the research are:

1. By far the largest three crops are tomato, pepper and onion

The analysis shows that by far the three largest vegetable crops in Benin are tomato, pepper and onion. Acreages of tomato, pepper and onion were respectively around 40,000 ha, 28,000 ha and 4,000 ha (with carrot cultivated on around 800 ha). The pepper acreage combines both chili and habanero pepper. The most important production areas in the South (zone 1: Ouémé-Atlantique-Mono) and the North (zone 7, Vallée du Niger).
It is estimated that around 100,000 farmers are involved in the production of vegetables, with larger average land sizes in the North (0.75-1.0 ha) than in the South (0.25-0.5 ha).

2. Vegetable production largely takes place with irrigation; two main production areas

Irrigated vegetables dominate the production system, with 90% of the farmers using irrigation in the South and 70% in the North. Irrigation in the North largely takes place by gravity irrigation with as a source the Niger river. Water is transported through canals and collected in 'boxes' (fadama irrigation system), where the plots are flooded.
In the South the dominant systems are tube wells and boreholes, with sprinklers and drip irrigation to supply the water to the crops. Production challenges occur with the flood system in the North obstructing aeration of the roots and the sprinkler systems consuming a lot of fuel.

3. Yields for the main crops are low, also compared to neighbouring countries

Even though most vegetable production is done by irrigation, yields are low. The following table shows that this is the case also compared to neighbouring West African countries, Burkina Faso, Ghana, Niger and Nigeria.

Table 21

Yields of three main vegetable crops in Benin, Burkina Faso, Ghana, Niger and Nigeria in 2019 (in ton/ha, source: FAOStat)

	Benin	Burkina Faso	Ghana	Niger	Nigeria
Onion (dry)	14,3	16,7	19,4	34,9	2,3
Pepper (green)	2,6	5,3	9,7	10,0	3,8
Tomato	7,3	10,9	4,3	25,5	4,6

The table 21 shows that especially for (chilli) pepper the other four countries record much higher yields. Also given the importance of pepper for vegetable farmers (cultivated on 28,000 ha), combined with a large processing industry, there is much potential to improve these yields. For onion Benin scores slightly lower than Burkina and Ghana, while for tomato it scores lower to Burkina and higher to Ghana. In general, Niger, with its well-organized irrigation system and conducive winter climate has much higher yields than Benin.

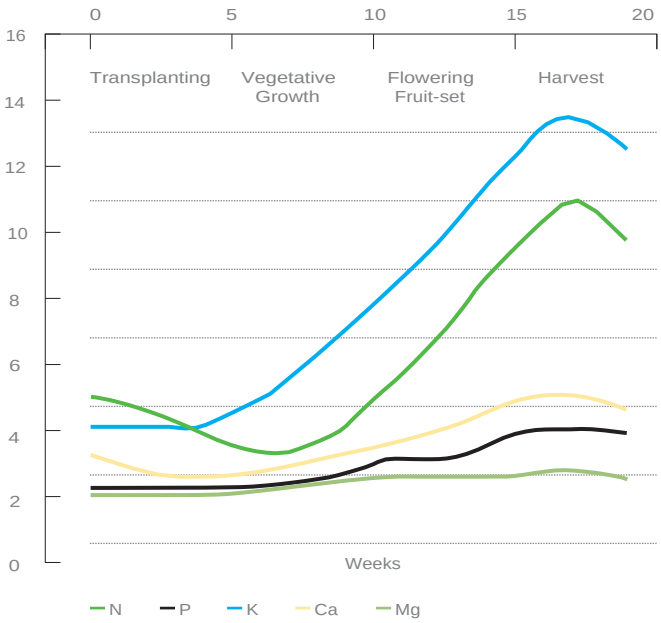
4. There are gaps in the availability of appropriate inputs for vegetable production, in particular fertilizers and crop protection products

Looking at the portfolio of varieties available to vegetable farmers there seems quite a wide range available for tomato and pepper from well-known vegetable breeding companies (East West, Rijk Zwaan and Technisem). Only for onion the number of improved varieties looks limited with Violet de Galmi (from Niger) the leading variety. Especially for Southern Benin better varieties are available and could be tested.

The biggest gap seems to be in place for fertilizers, with NPK from SODECO dominant. The NPK type (mostly used for cotton production) is of the 13-17-17 type with relatively low nitrogen content. Farmers can complement this by Urea, especially at the early (vegetative) growth stage. Still for the flowering and ripening stages, more specialized nutrients are required, e.g. calcium, magnesium and higher levels of potassium. Unavailability of these types of fertilizers can be a cause for the experienced low yields.

Roughly, the below graph provides the tomato nutrient requirements during the growing season, showing higher requirements of nitrogen, potassium, calcium and magnesium during the later stages of crop production. Phosphorus, though well provided in the dominant NPK formula, is less demanded for tomato production. Ideally potassium nitrate would be applied during this stage, combined with a mix of micronutrients that include calcium, magnesium, sulfur, zinc and boron.

Figure 7 Macro and meso nutrient requirements of tomato during the growing season (Haifa group).



Something similar is in place for the crop protection products with cotton-oriented pesticides dominating the market. A study from 2020 showed that the majority of the pesticides used in the South have formulations targeting pests and diseases in cotton. The range of available pesticides and fungicides with the following six being most commonly: Abamectin, Lambdacyalotrin, Cypermethrin (all for insects) and Mancozebe (for fungal diseases).

In general, enforcement of seed and pesticide regulations is poor and many products are imported illegally into the country. An important source for (unregistered) varieties and crop protection products is Nigeria. There are questions with respect to the quality of these products.

6. The government has a role to play in ensuring quality of seeds and crop protection products

Many of the seeds and crop protection products in Benin are illegally imported and farmers experience challenges in terms of germination and efficacy of pesticides. Quality deterioration can be because of the source (the manufacturer, also bringing in illegal products), because of the

agrodealer storage practices (leaving the products exposed to high temperatures) and/or because of counterfeiting (repackaging, fake seeds). For each of these malpractices the government has a role to play. In other African countries risk assessments have been made to assess at which point the greatest quality infringements occur, and at those points inspections can take place to improve the situation (e.g. at import level in the port, at the land border, or at the agrodealer shop). This requires political will and a well-staffed and resourced inspection service.

7. Prices for vegetables are low and fluctuate through the year, with relatively high average prices for onion and carrot

Overall prices in Cotonou are lower than in neighbouring capitals like Accra and Lagos. Looking at the wholesale price of tomato, Accra on average pays EUR 0.80 per kilo, Lagos the same, while the price in Cotonou's main wholesale Dantokpa market is around XOF 200 or EUR 0,30 (Tomato price fluctuation is very high in Benin. During the abundant season the price could be on average XOF 200 but during the shortage period it can go up to 1500 XOF per Kg). For the other two crops the price differential is smaller, though prices paid in Cotonou are 20-30% lower on average than in Accra and Lagos.

Within Benin prices also fluctuate according to the main production seasons, with an irrigated dry season between October and March, and two rainy seasons between April and June, and September and November in the South. In the North there is one rainy season from June to September. Because of climate change these seasons are shifting and rainfall is becoming more irregular; this in turn leads to a greater need for (supplementary) irrigation. Price fluctuations are clear for chilli pepper in the North, which vary between FCFA 130 in the main harvesting season (January-March) and FCFA 300 when production is low. For tomato something similar can be observed with price fluctuations between FCFA 50 and FCFA 300. This price difference creates opportunity for processing (dried, paste, sauce) and storage. In addition, greater price transparency can help farmers make informed decisions on their production planning. Also, digital trading platforms (e-commerce) can play a role in this.

8. Postharvest losses are high and there is a limited choice of packaging materials

Postharvest losses are estimated at 30% for tomato, 10% for pepper and 20% onion. Losses are experienced during the production and transport (when packed in large bags and boxes), and at the wholesale market. In Nigeria smaller 25 kg plastic crates were introduced some years ago and after some initial hiccups have become the standard. It is estimated that around 50% of the tomatoes sold at the main wholesale market 'Mile 12', in Lagos, is traded in these 25 kg crates. Major project investment was needed to transform this system. The transformation in Nigeria required a strong buy in from the traders at Mile 12; probably something similar will be needed in Benin (either starting with a group of buyers at the main wholesale market, or a group of supermarkets working together).

9. Demand for vegetables is highest in urban areas with consumer emphasis on price and physical quality

In general, the consumption of vegetables is lower in rural areas than urban areas, with carrot almost exclusively consumed by urban households. In urban areas, poor households relied more on dried chilli pepper and imported tomato paste, being more affordable than fresh habanero and tomato. More affluent households (in both rural and urban areas) consumed fresh tomato, habanero pepper, onion, and carrot. Household preferences for vegetables are mainly informed by physical quality aspects like size, shape, freshness and colour, and less by the variety and production system (i.e. conventional versus organic production). In general, most consumers are very price sensitive focusing on volume instead of quality.

10. There is an upcoming segment of high-end markets in Cotonou through hotels, restaurants, and supermarkets

In line with the above consumer findings, a more high-end market segment of restaurants, hotels and supermarkets is emerging, in and around Cotonou. This segment comprises less than 10% of the market but does provide opportunities for more specialized (quality conscious) wholesale and retail. Specific preferences are in place for locally

produced carrots, white onions from the North. Also, the number of supermarkets is increasing, in and around Cotonou. Supermarkets often source directly from farmers and pay a premium for physical quality.

11. Export potential to Nigeria is large, also in the light of the ratification of the African Continental Free Trade Area (AfCFTA)

The main export market for Benin is Nigeria, with Lagos at the doorstep. In general, prices in Lagos (at the Mile 12 international market) are three times as high as at Dantokpa in Cotonou. Demand for fresh vegetables, driven by population and economic growth, will increase in the coming years, and Benin is well positioned to fill this gap. Outside of the harvest season in Nigeria's North (January-March), market demand seems unlimited. In South Benin, the most exported vegetables are tomato, dried chilli pepper, fresh habanero pepper and carrot. Exporters do incur higher costs, in terms of sorting, grading, cleaning, transport and custom fees; with high losses of 20-30% due to transport time and large-size packaging bags (250 kg). It is anticipated that the African Continental Free Trade Area, that came into force last January 2021, will further reduce (or completely nullify) custom duties between the two countries.

12. There are many small-scale (artisanal) processing businesses, with dominance for dried pepper and tomato

It is estimated that Benin has more than 500 rather small-scale vegetable processors. Tomato and pepper are by far the most popular vegetables for processing, with end products like tomato paste/ concentrate, tomato sauce and dried pepper and powder. These activities especially take place in South Benin, close to the main consumer markets. Processors are mainly women (>75%) aged older than 25 with higher education (mostly university). Currently prices for dried chili pepper are around FCFA 1,200 or USD 2 per kg with world market and regional prices at USD 3 per kg (FOB Accra). Also, multinational buyers (like Indomie) could be interested to source pepper from Benin – if produced in the right way (hygienic, HACCP certified, with the right quality specs in terms of varieties used, particle size and moisture content). Given the low prices of chili peppers in the North during peak season, this provides an interesting business opportunity. This does require upscaling of the current production capacity, of 1 to 2 tons per year to 250-500 tons per year (to recoup investments in more professional processing equipment and certification). In turn, such an investment requires a financing solution, linking up the processing (M)SME with a bank or development finance organisation that can provide more favourable financing terms (e.g. Rabobank Foundation).

13. Other projects in West Africa show promising results

Experience from other countries in West Africa show that tapping into commercial finance for vegetable SMEs is not easy. Often companies are too small, lack track record and financial management systems to comply with bank requirements. On the other hand, some (smaller) finance solutions have shown promising results. In particular a solar irrigation project that combines a technical solution with (monthly) pay-as-you go payments over a period of 2 years. In addition, the establishment of a missing middle fund that combines a partial guarantee (50%) with technical assistance, and smaller ticket sizes (in the range of USD 10,000-50,000) looks promising as well. The latter will require donor support (and cannot be run purely commercially). In addition, from experience in Ivory Coast, low-cost rain shelters, locally called ABRIs, combined with soilless cultivation, drip irrigation and specialized fertilizer, show promising results. Given that vegetable prices in Ivory Coast are more similar to Benin (than those of Accra and Lagos) these innovations look interesting. The mass-training approach of NABC and East West Seed Knowledge Transfer could provide interesting lessons for Benin, though already the HortiBenin project implements similar activities in Benin at the moment.

14. Dutch business interest is mostly focused on agricultural inputs: seeds, fertilizer, and biological crop protection products

Also looking at other West African countries, most vegetables business interest is focused on seeds, and to a lesser extent on other agricultural inputs like fertilizers and substrate, and crop protection products. Some other technologies are being traded by Dutch companies (like Holland Green Tech in Benin) including irrigation equipment

and small-scale greenhouses, others are locally manufactured. In terms of seed companies, currently East West and Rijk Zwaan are active in Benin. These two are also the most active in other West African countries like Ghana and Ivory Coast. In addition, a number of other seed companies are active in West Africa, including Bejo (focus on Sahel countries with a strong onion and brassica portfolio), Syngenta (in Ghana and Nigeria), Bakker Brothers (in Ghana and Nigeria), and Enza (in Nigeria). Looking at the crop portfolio in Benin especially good onion varieties are missing (while tomato and hot pepper are being supplied by East West, Rijk Zwaan, Technisem and Tropicasem). In addition to these companies, specialized fertilizer (from e.g. Van Iperen), substrate (from Jiffy) and biological crop protection products (from Koppert) could have demand in Benin. Last, protection cultivation equipment (greenhouses, tunnels, rain shelters) could be an interesting avenue, though given the relative low prices for tomato (and low consumption of bell peppers and cucumber) these need to be very low-cost.

In addition to inputs and equipment, the Netherlands has a lot to offer in terms of knowledge and expertise. Both in terms of private consultancy companies (like Delphy and Profyta – active in Ghana and Nigeria) as well as knowledge institutes (Wageningen Plant Research). Benin could benefit from this knowledge both for open field and protected cultivation, though already Holland Green Tech and East West (through its Knowledge Transfer foundation) bring a lot of experience to Benin.

15. Youth are active in vegetable production; potential for more involvement because of high cash turnover in crops.

Many youth are active in the production of vegetables (both men and women). Vegetable production provides an interesting income generating activity for them because the crop cycle is short and it doesn't require a lot of land. Given the economic situation, with few formal employment opportunities, many educated youth are turning to agriculture. A recent study found that 67% youth involved in vegetable production around Cotonou and Porto Novo were educated (had at least completed secondary school). Importantly, the vast majority of them was able to cover their basic needs. Still, they face more constraints than adult men, especially where it concerns access to land and credit. Benin does have good training institutes for vegetable production, such as the Laboratory of Genetics Horticulture and Seed Sciences (GBioS) at the University of Abomey-Calavi, the Centre Songhai and the School of Horticulture at the National University of Agriculture, and 10 agricultural secondary schools. Combining trainings with youth entrepreneurship and access to finance could help young people to engage more professionally in vegetable production.

16. There are barriers for women involvement in processing and agriculture

Women are particularly involved in wholesale and retail trade, as well as processing. As indicated above, business opportunities exist in further professionalizing and scaling up of tomato and pepper processing. For the latter there are constraints in terms of access to finance to expand their business (investing in hardware and accessing working capital). In addition, the micro-enterprises can improve their performance through more knowledge on food safety, packaging and branding.

Women are less involved in primary production with estimates of 20% female farmers in the North and 30% in the South. The main constraint for women is access to land, and they have to disproportionally rent land compared to men (32% vs. 21%). Both for primary production and processing opportunities can be targeted directly at women. Both are described above under 10. processing and 15. youth.

4.2 Lessons learned for Dutch private sector to start investments→

From Benin

The Dutch businesses in Benin (East-West Seeds, Holland Green Tech, Rijk Zwaan) tend to operate in supplying inputs for local production, in competition with other businesses (Acceuil Paysan, Benin Semences, and many other small enterprises). They sell improved seeds of especially exotic European vegetables rather than local vegetables. Our study confirms that there are existing opportunities for quality seeds to penetrate the market and improve the production of selected vegetables (tomato, chilli pepper, habanero pepper, onion, carrot). However, our discussions with the stakeholders confirm that

other well consumed local vegetables such as gboma eggplant, crincrin, okra, and amaranth also present interesting opportunities for seeds development. For instance, there is already ongoing research by East-West Seeds on gboma eggplant and crincrin.

Another sub-set of some of these companies (Holland Green Tech; Flo-Grow) provides vegetables equipment such as small-scale irrigation systems, greenhouses, and even mechanisation equipment fit for small-scale production, also in competition with other businesses (DIVATEC, Acceuil Paysan). Increasingly the Benin market is looking for vegetables import substitution, favouring investments in value-chains like tomato, onion, pepper, and carrot that need high-value inputs. Clearly, this dynamic, supported by an improvement of the business environment, opens up avenues for Dutch businesses to supply high quality seeds, fertilizers, crop protection products, and equipment such as greenhouses, storage, and irrigation systems, instead of creating modern farms to produce vegetables.

At the other side of the coin, it is important to ask whether Dutch input suppliers have solutions that are adapted to the prevalent production systems in the country. In Benin, there are overwhelmingly small-scale producers who are sometimes organised in cooperatives, though not well organized. Dutch greenhouses, irrigation systems, and mechanisation equipment could be too expensive, too sophisticated, and better suited to a larger scale of production. To some extent, more technical skills are often needed than with cheaper equipment imported from countries such as India, South Africa, and China. Therefore, it is important that proposed equipment fit with the small-scale production level, are affordable, and require less skills and little maintenance.

Furthermore, the Netherlands has expertise in storage where Dutch suppliers have good technology to install cold storage rooms for vegetables. However, for the storage technology to succeed, it is important that producers grow quality products with low loss rates in storage, which is a new phenomenon to be developed and accompanied. To make it happen, initial development and research projects are needed to engage producers' organizations, especially the lead producers, in an interactive learning process where they will value the benefits of quality inputs and equipment, rather than relying on informal and uncertified sources. This way, there is a chance to build the required conditions to strengthen the vegetables sector. For instance, a similar journey is currently pursued by a Dutch private sector consortium, led by Holland Green Tech, that is testing the market through the HortiBenin project with 40 lead farmers to introduce their quality inputs and equipment.

From other vegetables projects in West Africa

HortiFresh – Ghana and Côte d'Ivoire

The HortiFresh programme is an initiative funded by the Netherlands Embassy in Accra. The programme focuses on the commercial fruit and vegetable sector in Ghana and Côte d'Ivoire; aiming to improve its international competitiveness and sustainability. Under the programme a number of activities are being supported: (1) innovation funding for innovative business initiatives; (2) support for access to finance for established vegetables companies; (3) geographic cluster initiatives; and (4) work with the government to improve the enabling environment. Being in its fourth year, the programme has achieved the following results:

- A new type of multispan greenhouse has been introduced with two companies; showing promising results after initial hiccups. This type of mid-tech investment (a 5,000 m2 multispan using indeterminate and semi-determinate varieties, substrate, trellising, and specialized fertilizers and crop protection) is probably not feasible for Benin, as tomato prices in Accra are roughly twice as high on average as in Cotonou (EUR 1,00/kg vs. EUR 0,50/kg).
- A number of agroprocessing initiatives show success; these include a pineapple drying company, and dried pepper production plant. For both companies it is early days, but the underlying business opportunity looks promising. Robust equipment from South Africa (through Dryers for Africa) is being used, which can be installed modular and is scalable. More professionally run factories require more strict hygienic standards and certification (HACCP). Products can be supplied to the local/regional (e.g. Indomie) and EU markets.
- For Accra a number of specialized fresh fruit and vegetable (FFV) wholesale and retail initiatives have started up in the past decade. These include formulas that (partly) source directly from farmers, with higher quality parameters, with some enforcing the local GAP standard Ghana Green Label. Some of these companies

have invested in convenience food (sliced and diced, and mixed packages) supplied to major supermarkets or own outlets. For Benin, and Cotonou specifically, this could provide an interesting example; more closely linking farmers to markets and exploring premium prices for quality vegetables (with high food safety and physical quality).

- Exports of so-called Asian vegetables to the EU have experienced challenges over the past years, due to more stringent phytosanitary requirements in the EU and resulting (voluntary) export bans in Ghana. Two supported companies are managing to continue exports of crops like okra, tinda, and a number of gourd types (focusing less on ravaya and chilies). Probably for Benin this provides less of a business opportunity, given the fact that most exports are destined for the UK, with frequent flights linking Accra and London.
- A new financial product has been developed with PEG solar irrigation systems. The relatively large 12 or 24 panel systems (providing resp. 2.2 kW and 5.5 kW) can irrigate resp. 0.5-1 and 1.5-2.5 hectares. Given high electricity prices in Ghana and frequent outages the systems are popular with farmers and provide a payback period of around five years. The systems are provided on a loan basis, with a 20% advance payment and monthly instalments due for a period of two years.
- In addition, a special training programme has been developed for women entrepreneurs and managers; the HortiFresh female-led horticulture business accelerator. Through the programme 14 women-led horticulture businesses receive business management training. The companies are also supported to develop business plans and are linked to financial institutions to fund these. Given EKN-COT's emphasis on women empowerment and green agribusiness this could be an interesting model for Benin as well. Possible financing could come from the Orange Corners initiative that is supported by the Dutch Ministry of Foreign Affairs globally (with similar projects in Ghana and Nigeria).
- All of the innovation fund, access to finance and cluster activities are accompanied by agronomy trainings; supporting farmers on all aspects of crop production, from seedling raising to pest and disease management, and from soil fertility practices to post-harvest handling and storage.
- Access to finance has been a relatively big component in the HortiFresh project. As such the project developed a so-called 'missing middle fund' with ABSA and the Rural Development Fund (RDF). Through this facility horticulture MSMEs can access financing in the range of EUR 10,000-50,000; the bracket that is associated with the 'missing middle' type of companies that are too big for microfinance but too small for regular commercial finance. In addition to loans, the missing middle fund provides additional support to interested companies through a 50% guarantee scheme (by RDF) and support for developing business plans and implementation support (by HortiFresh). Something similar could be developed for Benin, e.g. looking at Dutch support from Invest International.
- In terms of work on the enabling environment, the HortiFresh programme is supporting the Government of Ghana in establishing a Horticulture Development Authority (HDA). It is envisaged that the HDA operates as a private sector-led organisation that supports the broader development of the commercial fruits and vegetables sector. It is the ambition of the HDA to become a self-regulating body, that can impose tariffs and production regulations, as well as support joint initiatives in terms of R&D and marketing. In addition, HortiFresh works together with the Food and Drug Authority (through a dedicated taskforce) to monitor and further enforce food safety standards in the F&V sector. Lastly, the programme has supported the development of the Ghana Green Label, a local good agricultural practices standard that guarantees environmentally sound and healthy vegetables in the local market.

HortIvoire - Côte d'Ivoire

The so-called 'impact cluster' project HortIvoire supports the establishment of a vegetable training centre in Tiébissou, close to Yamoussoukro in Côte d'Ivoire. The project runs from 2020-2024 and will train 240 interns on 'hors sol' production. In addition, 3,200 vegetable farmers will visit the center's field days. The impact cluster consists of four companies Agrifer, Rijk Zwaan, Van Iperen and Resilience. The project presents a combination of innovative production technologies, including a rain shelter (ABRI) and INNOFER package of inputs (substrate, drip irrigation, hybrid varieties and specialized fertilizer). Yields reach 10 kg/m2 for tomato, with professional sorting / grading and quality packaging material, the products fetch a premium in the market. Prices for tomatoes

are lower in Yamoussoukro and Abidjan than Accra and Lagos, with around EUR 0,50 per kg (comparable to Cotonou). This type of system could be worth exploring in Benin as well; as it forms a relatively low-cost technology that protects the plants well during the rainy season (when production is low and prices are highest).

Photo 6

Example of HortIvoire ABRI (rain shelter) and tomato production at the training centre in Tiébissou, Côte d'Ivoire

SDGP – Transforming Nigeria's vegetable markets

The Sustainable Development Goals Partnership project 'Transforming Nigeria's Vegetable Markets' is implemented by a consortium of East West Knowledge Transfer, Solidaridad, the Ahmadu Bello University (ABU) and Ministry of Agriculture in Kaduna. The project aims at a significant productivity increase of the domestic vegetable sector by bringing knowledge and introducing new varieties and adapted technologies from the private sector and evidence based knowledge and skills from reputable Universities. The project demonstrates and disseminates new farming practices to the vegetable farmers in Kaduna and Kano States in Nigeria. The project has four main components: (1) Training of trainers in sustainable vegetable production (high level professionals); (2) Development of input markets for farmers; (3) Farmer training and knowledge transfer; and (4) knowledge development, dissemination and sharing. Within the project more than 50,000 farmers will be trained. For Benin, this type of mass training could be interesting as well, focusing on the two largest production areas in the north and in the south. Seed companies and training organisation could join forces with local stakeholders to develop such a programme (when a new call for SDGP projects is announced).

A similar approach is developed by SAFEVEG (2020-2025), a project funded by the Dutch government and EU, from the promotion of production technologies among farmers to the improvement of the local consumption of vegetables including consumers' willingness to pay for quality products. The project is led by WorldVeg center with 5 partners (WUR, CIRAD, INRAB, INERA, and IER).

Seeds4Change 2019-2021 (NABC and 6 companies)

The Seeds4Change project is implemented by a consortium of the Netherlands-African Business Council, five vegetable seed companies (Syngenta Seeds, East West, Rijk Zwaan, Bakker Brothers and Enza Zaden) and a supplier of biological crop protection products (Koppert Biological Systems). The project focuses on the development of the vegetable sector (five crops: tomato, onion, cabbage, watermelon and pepper) in the Kano region (Nigeria) by the provision of quality input materials (hybrid seeds, crop protection and fertilizers) adjusted to local circumstances. The project organizes trainings and demonstrations focusing on crop management and good agricultural practices. By its design, this project looks similar to HortiBenin (with Holland Green Tech in the lead). A different package is developed but the training and demonstration elements are comparable.

4.3 Major sector bottlenecks →

Taking into account all the main findings, a number of major bottlenecks for further growth of the vegetables sector can be distilled:

1. Benin's vegetable sector is characterized by a low input low output model

Also compared to neighbouring West African countries, yields in Benin are low. Main causes for this are inadequate irrigation practices and equipment, limited use of improved varieties as well as low of appropriate varieties for some crops (especially onion in the South). Additionally, specialized fertilizers are limited available, and the range of appropriate crop protection products (and especially the range of active ingredients) is limited. Furthermore, farmers have limited access to price information and finance, which makes it difficult to plan and invest. With respect to the inputs the government has a role to play to ensure effective and quality products are sold in

the market. Opportunities exist especially for new onion varieties and given relatively high prices for onions this looks like an interesting business opportunity.

2. Climate change will cause higher temperatures and more erratic rainfall

The impact of climate change will lead to a combination of higher temperatures and extreme weather events. This will further exacerbate the occurrence of crop failures (e.g. due to droughts, storms and/or floods). More investments (and related financing) will be required to invest in irrigation equipment like boreholes, pumps, sprinklers, and driplines, as well as, potentially, protected cultivation; so as to produce under more extreme weather conditions. Interesting new technologies are being piloted in other countries, like solar irrigation and rain shelters. Benin could also experiment with these, as part of a broader strategy on climate smart agriculture.

3. There is an increasing demand for consistent supply of quality vegetables that is not being met

Most supermarkets, restaurants and hotels have difficulties sourcing a consistent supply of quality vegetables year-round. In addition, prices fluctuate heavily according to the season with major supply coming from the North during the months of December to March and from the South during July till November. Prices especially spile during the period April-June (when temperatures in the South are too high). A partnership between specialized wholesale / retail and vegetable producers will probably be needed to make these investments. Sales of quality vegetables can be outside of Benin as well, with wholesale and retail prices being much higher in neighbouring Lagos.

4. Processing of vegetables is small-scale and fragmented with limited access to finance

There are more than 500 small-scale processors active, mainly in the South of Benin. These micro enterprises are mostly run by women above the 25 that are well-educated. Due to limited access to finance (both for working capital and investment in equipment) these enterprises have difficulties to expand. Given the high price fluctuations in pepper and tomato (from the North) this appears an interesting business opportunity. Also, these companies could engage in exports if the right quality specs are being met (in terms of hygiene, hotness and particle size). Comparisons with other West African countries, most notably Ghana and Nigeria, shows that Benin has a competitive advantage.

4.4 Business opportunities and financing opportunities →

Directly addressing the four sector bottlenecks above we developed four business opportunities that bring together a number of the following criteria: critical issues addressed in the value chain, market size, commercial profitability, potential interest from Dutch companies, and impact on women and youth. In addition, we described the possible funding opportunities that could kick-start the business opportunities.

Business opportunity 1:

Increasing productivity and storage of onions in Benin

Background:	Onion productivity in Benin is low, with farmers producing on average 14 t/ha. This is 17% lower than neighbouring Burkina Faso, 36% lower than Ghana and 140% lower than Niger. At the same time prices are relatively high with an average price of FCFA 225 or EUR 0.34 per kilo. In addition, production conditions in the south are good with relatively loose soils and shallow groundwater availability. In the North (Malanville area) suitable (alluvial) soil conditions are in place at the river banks of the Niger river. There are other opportunities for increasing the yields of tomato and pepper as well, but these activities are currently already supported through the HortiBenin and SafeVeg projects.
The opportunity:	The Netherlands is world leading in vegetable breeding and onion is part of the portfolio. Companies like Bayer-Nunhems, Bejo, Enza and Syngenta (in addition to East West who is already present in Benin) have developed very good short day red and white onion varieties, that are high yielding. Yields achieved in (lowland) Kenya approach 50 tons/ha provided good crop care is applied. Especially soil nutrient management and thrips management is important in this respect. A combination of organic matter (cow dung, compost) and specialized fertilizer is preferred to achieve maximum yields. Onion production doesn't like sprinkler (or spray tube) irrigation and either furrow or drip irrigation needs to be applied. The opportunity can be combined with low-cost storage structures, as developed by Beemsterboer and Bejo in Senegal. A combination of cultivating the right onion varieties, proper curing of onions in the field (before harvest) and low cost storage structure (with sufficient ventilation), can increase shelflife by months. Photo 7 **Local onion storage structure developed by Beemsterboer and Bejo in Senegal (courtesy: André Dekker)** 
Market size and demand:	There is a total of 4,000 ha of onion production in Benin (DSA/MAEP, 2020). Out of this 20% could be converted into intensive production with the use of hybrid (red and white) onion varieties. Seeding rate of onion is around 8 kg/ha, creating a potential market size of 6.4 tons of hybrid onion seed. 800 ha of improved onion production, in turn, would lead to a production of 40,000 tons of onion. The current demand in Benin is around 160,000 tons, with good export opportunities to Nigeria as well.

Potential activities:	- Trials and demonstrations of improved (red and white) hybrid onion varieties - Trials and demonstrations of better soil fertility management, with a combination of organic and inorganic inputs - Trials and demonstrations with biological crop protection products to combat thrips - Training of farmers on good agricultural practices of onion production, including irrigation, soil fertility management, pest management and curing of onions - Introduction and demonstration of low-cost storage facilities
Target group and scope:	The business opportunity could focus on young (male and female) small-scale farmers both in the North (on the alluvial river banks) and in the South (on the sandy soils).
Potential partners:	- One of the Dutch breeding companies, e.g. Bayer-Nunhems, Bejo, Enza or Syngenta - A specialty fertilizer company like Van Iperen - A biological control company like Koppert, focusing on thrips management - A local manufacturer of low-cost storage systems, based on the above presented design
Funding	The above business opportunity could be supported by the Impact Cluster instrument of opportunities: RVO. In an impact cluster at least 3 (but preferably 4) Dutch companies work together on a development challenge/ opportunity. Sustainable onion production and storage in Benin provides such an opportunity, with many smallholder (young) farmers involved, a large yield gap, good output prices and high postharvest losses (20% for onion). The Impact Cluster instrument can provide a maximum co-financing (subsidy) support of EUR 450,000 with a typical implementation period of 3 years.

Business opportunity 2:

Private sector-led climate smart vegetables innovations

Background:	Climate change is posing a number of threats to Benin's agriculture and vegetables sector. Rainfall will become more erratic, temperatures will further rise and the number of extreme weather events will increase. This holds true both for the production areas in the South and the North of Benin. Looking at the most important sources of irrigation water; the Niger River in the North and shallow ground water in the South, there is a need for doing more with less as well ('more crop per drop'). A number of innovations can be piloted to address these challenges.
The opportunity:	Depending on the risks a number of new technologies can be piloted that address the impact of climate change: - **Excessive rain in the main rainy season in the South (May-July):** It is expected there will be more frequent occurrence of torrential rains and floods in the south[16]. Excessive rain can be addressed by introducing rain shelters or ABRIs (like developed in Ivory Coast). The example of ABRIs has been highlighted in Chapter 3: Lessons learned from other horticulture projects in West Africa. In addition to this drainage needs to be optimized, introducing gutters and canals to get rid of peak flow water during extreme weather events. In addition, (bio-degradable) agricultural fleece (agro-fleece) can be used, during the early stages of crop growth in the wet season; to give the plant a strong start. The fleece protects the young plant from rainfall and pest attacks. Agricultural fleece is being tested in a number of countries in southeast Asia at the moment. Both innovations are particularly interesting as prices are highest during this period of the year. - **Lower rainfall/water stress:** Especially in the South a reduction in rainfall is expected; by 2050 this area is expected to receive 100-200 mm rainfall less than in 2000[17]. This means (supplementary) irrigation will become even more important than it is at the moment. Innovations for irrigation systems include solar irrigation and soil sensors. The first reduces reliance on fossil fuels, and is increasingly price competitive compared to diesel pumps. Experiments with a medium-sized solar irrigation system (twelve panels with a 2.2 HP pump) has shown success in Ghana (especially in the Keta-Denu) with a payback period of 3 years. Importantly, soils in the South are very low in organic matter (due to continuous cropping) which in turn reduces the capacity of the soil to retain water. A combination of sound organic matter management, fertilizer applications and need-based irrigation will be required to optimize crop yields. In this respect the use of soil sensors is recommended. In Mozambique, pilots showed that farmers can reduce their irrigation application by 50% and increase yields through the use of soil sensors[18]. The latter innovation can be used in the North as well, as irrigation practices are particularly inefficient there, using the *fadama*/flood irrigation system. - **Higher temperatures:** Mean annual temperatures are projected to increase by 1.0 to 3.0°C by the 2060s and already the average number of 'hot' days per year increased by 39 between 1960 and 2003, and hot nights by 73 in the same period[19]. The latter is especially important for the production of tomato, that starts flower abortion by night temperatures of above 21°C. A number of seed companies have developed varieties that are more tolerant to high temperatures (e.g. East West Seed). Adaptability tests in Benin could support the introduction of new varieties. In addition, shade netting during the hottest months of the year can help out.

[16] Ministry of Foreign Affairs of the Netherlands, 2018, Climate change profile: Benin.

[17] Idem.

[18] E.g. see: https://resiliencebv.com/publications/improved-soil-water-management-by-the-use-of-the-soil-humidity-sensor-in- the-apsan-vale-project-in-mozambique/

Market size and demand:	The above climate smart agriculture technologies and practices can be applied to the farming systems of both north and south Benin, and can be used for all vegetable crops, though the rain shelters are more suitable for tomato and pepper production. As such, a selection of them can be used by all farmers.
Potential activities:	- Pilot rain shelters or ABRIs, as well as agro-fleece in the South - Pilot solar irrigation and soil sensors in a number of locations in the South - Develop soil fertility management trials in the south, combining application of organic and inorganic fertilizers - Develop variety trials for more heat tolerant varieties in the North and the South, and experiment with shade netting - Combinations (packages) of the above technologies and practices can be demonstrated as well Photo 8 **Use of solar irrigation and spray tubes for lettuce production in Keta-Denu, Ghana (Courtesy: HortiFresh)** 
Target group and scope:	Looking at the affordability of some of the technologies (e.g. the ABRIs and solar irrigation systems), focusing on the more commercial and larger vegetable farmers will be logical.
Potential partners:	- Already SafeVeg focuses on the introduction of climate smart vegetables technologies and practices; they could be involved in testing more of the above proposed innovations - Agrifer in Ivory Coast has developed rain shelters (ABRIs) and a package of inputs for high productivity of tomato and pepper production - East West Knowledge Transfer experiments with agri-fleece in Southeast Asia - PEG Africa has developed a pay as you go solar irrigation system in Ghana - Dutch seed companies have developed more heat tolerant tomato varieties (East West, Profyta) - APSAN VALE in Mozambique has built experience on the use of soil sensors to increase water use efficiency
Funding opportunities:	A number of the above business opportunities can be tested by the SafeVeg project (partly funded by the Netherlands government) and/or HortiBenin. A number of other business opportunities can be taken up directly by the private sector (including solar irrigation). Possibly an additional Impact Cluster project can be designed that focuses on testing a package of (private sector led) climate smart agriculture technologies.

Business opportunity 3:

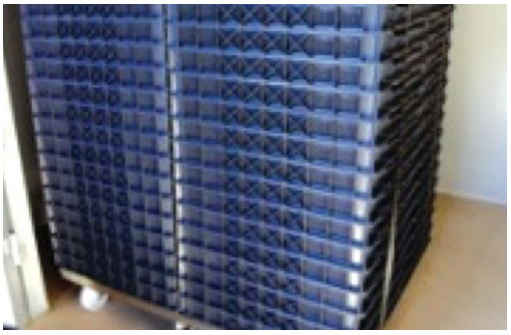
Dedicated wholesale/retail outlets that source directly from (groups of) farmers

Background:	Urbanisation is increasing in Benin, with Cotonou (and its periphery) as the main centre. The metropolitan area of Cotonou- Abomey-Calavi and Sèmè-Podij, combined with Porto Novo has an estimated 2 million inhabitants that increasingly demand higher quality vegetables. This is supported by the increase in supermarkets, with a number of hotels/restaurants also looking for a single supplier of fresh fruits and vegetables. Supermarkets, hotels and restaurants, in turn, are looking for quality consistent supply year-round, which currently is not available.
The opportunity:	There is room for a specialized wholesale/retail outlet that can supply year round quality vegetables to the main supermarkets, hotels and restaurants of the Cotonou metropole. The outlet can directly supply to households as well. In Ghana a number of similar initiatives gained ground in the past decade with companies like Farmers Market (targeting consumers) and Eden Tree (targeting supermarkets) expanding gradually. Farmers market currently has 5 outlets, and also does home deliveries, which have spiked since the pandemic of Covid-19. Given the size of Accra being 5 million inhabitants, one would expect one similar initiative in Benin would find sufficient demand. Eden Tree has a state of the art packhouse where it sorts, grades, cleans and packages the vegetables. In addition, ready made salads are made as well as sliced/diced vegetables for direct cooking. Eden Tree supplies to major supermarkets like Max Mart, Game, Spar, Citydia and Marina Mall. Photo 9 **Product portfolio of Eden Tree (left) and Farmers Market store in Accra, Ghana (right)**  In Ghana, another initiative is in place, called Ghana Green Label. A local Good Agricultural Practices (GAP) standard. The standard testifies that products produced under the label are safe and produced in an environmentally sound way. Eden Tree sources fruits and vegetables from GGL certified farmers.
Market size and demand:	The greater metropolitan area of Cotonou, including Porto Novo, has around 2 million inhabitants. Out of these one can imagine 5% to have the purchasing power and health consciousness to want to pay a premium for safe and quality vegetables. This amounts to 100,000 people, or around 20,000 households. This justifies (at least one) dedicated wholesale or retail company.

Potential activities:	- Find potential investors for a dedicated F&V wholesale/retail outlet - Establish close relationships with a number of (groups of) frontrunner farmers in the North and the South to guarantee year round supply of quality fruits and vegetables - Possibly develop a standard and label for safe and quality fruits and vegetables from Benin, that adhere to high hygienic and environmental standards - Develop convenience food products like sliced and diced vegetables, fresh juices and ready to eat salads - Possibly develop on online platform for home deliveries (and weekly F&V baskets)
Target group and scope:	The business opportunity could focus on slightly larger frontrunner farmers both in the North and the South.
Potential partners:	- A Beninese company (e.g. Jinukun store, Premium Hortus) that wants to invest in specialized wholesale/retail including F&V processing - A Dutch retail company (e.g. Ahold) that wants to support the initiative as part of its CSR agenda - An NGO or consultancy company with the Ministry of Agriculture, Livestock and Fisheries to develop the local GAP - Frontrunner farmers in the north and the south that want to supply to the wholesale/retail outlet
Funding opportunities:	The comprehensive initiative would probably need a longer term focus (4-5 years) to ensure year round certified produce is established. For such an initiative the old Sustainable Development Goals Partnerships (SDGP) programme of the Netherlands government would form an interesting entry point. The SDGP programme co-finances public-private partnerships, that consist of at least one NGO or knowledge institute, a company and a government organisation. In 2019 the last call for proposals was announced that focused on the following thematic areas: nutrition value, sustainable value chains, sustainable and climate-proof food production systems, and better work and income for youth and women. A co-financing subsidy of EUR 500,000 to EUR 3,000,000 is available. It is anticipated that a new Call will be announced in the first half of 2022 with a focus on youth employment, climate smart agriculture and sustainable food systems. The here presented initiative would match many of the requirements.

Business opportunity 4:

Professional small-scale pepper processing and exports (with a gender focus)

Background:	Benin has more than 500 small-scale processors of especially dried/ concentrated tomato and pepper. These companies typically process less than 2 tons of finished product per year, mainly targeting the period of low vegetable availability in the months of March till June. Processing is done in artisanal way, often unhygienic (outside) conditions. For a few of these companies a more professional set up, investing in a washing and (gas) drying facility could pay off.
The opportunity:	In Ghana a small-scale drying facility has been supported that produces dried pineapples. The company uses a Dryers for Africa gas dryer that can produce between 750 and 850 kg per cycle of 8 hours – for pepper (in this opportunity the model is a batch dryer that runs on gas). The initial investment would be around USD 60,000 for such a dryer (excluding building, generator and washing facility). Another USD 25,000 would need to be added for making the next step to well packaged ground pepper. In the Ghana business opportunity a payback period of 2.1 years was foreseen, with a 5-year IRR of 71% (source: HortiFresh, 2019). Fresh pepper in Benin can be obtained for around FCFA 250 per kg with around 4 kg needed to produce one kg of dried and ground pepper. So, in total FCFA 1,000 is needed for one kg of dried pepper. The sales price is around FCFA 1,650 (or USD 3 per kg), leaving a margin of FCFA 650 per kg of dried pepper for the processing costs (gas, electricity, labour, packaging material, depreciation of equipment). So, running a more professional gas dryer 200 days per year with 750 kg input of product, results in a margin of FCFA 19.5 million or around EUR 30,000 per year. This roughly should lead to a payback period of 3.5 years (EUR 80,000 for equipment and EUR 25,000 for other expenses). These are all very rough estimates and need further detailing when the business opportunity is operationalized. Photo 10 **The Dryers for Africa AD750 gas dryer with a capacity of 750 kg (fresh) product per cycle**  
Market size and demand:	The market for dried and ground chili pepper in Benin was estimated at around 49,000 tons in 2018 (FAOStat; chillies and peppers, dry). In addition to this, Nigeria imported around USD 3.6 million of crushed or dried pepper in 2020 (ITC TradeMap), which corresponds to roughly 1,200 tons. This business opportunity would target a production of 30 tons per year high quality, well-packaged chili powder (possibly in sachets).

Potential activities:	- Support existing women-led micro-enterprises involved in chili pepper drying to improve their business performance (business planning, technical support) - Work with a number of larger (women-led) processing companies on expanding the processing capacity and potentially exports - Support product development of new (seasoned) chili powder products, including new packaging and branding - Develop an access to finance product that specifically invests in the upgrading of drying facilities (hardware) and working capital to buy chilies when prices are lowest
Target group and scope:	Women-led micro and small-scale processors of pepper in southern Benin. Given the fact that around 80% of the 500 tomato and pepper processors are run by women, the focus group is quite large.
Potential partners:	- A number of women-led MSMEs that are involved in chili drying - Dry-More, a project that runs in Burkina Faso to support drying companies - Dryers for Africa, a South African based supplier of robust agri-dryers - An NGO or consultancy that can provide business and technical support - A development finance organisation
Funding opportunities:	This business opportunity would require some form of donor support as the targeted MSME companies are currently too small to tap into commercial financing (i.e. bank loans). As such a combination of access to finance and technical and business support is needed to implement this business opportunity. Given the thematic areas of: women entrepreneurship, youth employment and reducing postharvest losses (and possibly increasing exports), the business opportunity should be able to attract some form of blended finance (a combination of loans, grants and TA). Possibly CBI could support as well on the export promotion side and the Rabobank Foundation, FINADEV and Vital Finance Benin could be approached for providing development finance. E.g. Vital Finance is working together with the European Investment Bank to provide so-called meso finance to agribusiness companies that are too big for tradition micro-finance credit and too small for local banks; trying to overcome the 'missing middle' investment gap.

5.

Conclusion and recommendations

Addressing the food and nutrition security in Benin requires to make strong investments in the development of high-value agriculture sub-sectors; the vegetable sector being one of the most important in the country. The vegetable sector is an important industry that, employs thousands of people in urban, peri-urban, and rural areas and, is witnessing a growing demand of vegetables with the rapid population growth, especially in urban areas. So far, this growing demand could only be partly satisfied by the existing vegetables systems, justifying the need to investigate the sector and identify rooms to strengthen the vegetables sector. To address the knowledge gap, this study aimed to identify the bottlenecks and opportunities to strengthen the vegetables sector in Benin, where relevant through Dutch knowledge, technologies, and expertise. To achieve that purpose, an interactive and transdisciplinary approach was used to learn from the literature and the perspectives of active stakeholders that would benefit from the study's outcomes.

In general, there was an increasing dynamic in the vegetables sector with a growing number of economic actors from the production to the consumption segments as well as inputs suppliers. Youth (women and men) were active in vegetable production and particularly women in wholesale and retail trade as well as processing. After prioritizing the vegetables, tomato, chilli and habanero peppers, onion, and carrot made it the top five vegetables of interest for investments. From this top five vegetables, their by-products and market destinations were identified to make a long list of vegetables value chains. However, as vegetables are produced together in association or rotation, a combination of products and similar types of markets was made into fresh vegetables and processed vegetables and wholesale markets, regional markets, and high-end markets, respectively. Afterwards, an estimation and prioritization of the proportions of the market shares of these value chains generated a top-four value chains as follows, respectively: fresh vegetables for wholesale markets, processed vegetables for wholesale markets, fresh vegetables for regional markets, and fresh vegetables for high-end markets.

Furthermore, the investigation of these four value chains showed that producers, processors, traders/exporters, and consumers were facing some constraints that were impeding the potential of the vegetables sector to achieve economies of scale, improve food and nutrition security, and the livelihoods of smallholders, especially women and youth. These identified constraints were combined and reformulated into four major sector's bottlenecks as follows: Benin's vegetable sector is characterized by a low input low output model; climate change will cause higher temperatures and more erratic rainfall; there is an increasing demand for consistent supply of quality vegetables that is not being met; and processing of vegetables is small-scale and fragmented with limited access to finance. These bottlenecks, fortunately, also presented some interesting business opportunities for the local and Dutch private sector. Therefore, and considering ongoing business activities in the country, four business opportunities were developed and labelled as follows: increasing productivity and storage of onions in Benin; private sector-led climate smart vegetables innovations; dedicated wholesale/retail outlets that source directly from (groups of) farmers, and professional small-scale pepper processing and exports (with a gender focus). It is expected that these business opportunities entice the entry of experienced Dutch private sector to strengthen the vegetables sector in Benin.

Moreover, the study makes some recommendations as a follow-up to continue strengthening the vegetables sector in Benin. The recommendations are presented as follows.

Further research. Based on the findings from this study and the gap in existing knowledge, the study suggests conducting further studies to inform stakeholders of the vegetables sector in Benin. First, it is necessary to conduct a more detailed market study to understand the profiles and preferences of consumers as well as the demand volumes, supply gap, and quality seasons across the country. This study can be conducted around the towns throughout the whole country to detect areas of high demand and gap, and possibilities of vegetables aggregation. The study can also start with the selected values chains and detect possibilities of expansion to other vegetables. Next, and based on the low penetration of improved seeds among farmers, it is important that future studies delve into what constraints the seed market expansion and the sustainable adoption of good agricultural practices in the country. An interesting way to also learn is to start with some pilot interventions (e.g., HortiBenin project) with seed companies, to test business models and activities.

Business to Business (e.g. trade missions). Trade missions could be organized between local and Dutch private sector to improve business relationships in the vegetables sector in Benin. Both incoming and outgoing missions are necessary. Incoming missions in Benin for Dutch companies can enable them to quickly assess the business environment and meet with related local businesses for possible partnerships. These missions can also be regional and nicely target Dutch companies already operating in West Africa to increase their interest in expanding their business in Benin. It might also be interesting to organize the matchmaking relationships for companies that already express the need to connect to local businesses. Outgoing missions in the Netherlands for local companies can intensify their business relationships with Dutch companies. For this type of mission, the suggestion is to target nascent relationships between local and Dutch companies to improve and boost their business partnerships as these missions could enable Dutch companies to learn more about their local partners and how they can support in growing their businesses. For Dutch companies operating in the region, organizing regional outgoing missions for local companies would improve the confidence of the latter in their business partnerships as they would learn directly from the field outcomes of their Dutch partners. Local companies from production, processing, and agri-services (soil testing, storage, mechanization) levels and with broad possibilities for improvement are a nice target. Specific business criteria (production capacity, education level, growth potential, etc.) may be needed here for selection of promising enterprises so that the trade missions generate lasting business links and opportunities with Dutch companies.

At marketing level, the power of the women traders *(les bonnes dames)* does not make it easy for improvements. They are powerful but operate at small scale level and dispatch the market size into tiny parts. That makes it difficult for companies with bigger ambition to enter the market as that would mean to find a dumping strategy that reduces the aggregators to few marketers. Another way to face such situation is through the action of the government that can set and harmonize the measurement units like kilogram to reduce the inequalities created on farmers by these women. Further, it may be interesting to develop a business case to work with women and find incentives that motivate them as well to make the value chains more competitive. For example, and learning from Agriterra experience, cooperatives could employ middle women in the cooperatives instead of working against them in a sense.

Knowledge to knowledge. Here, the government is making strong investments into creating more TVETs and building the capacities of teachers on agricultural training. For that, the government already recruited a first cohort of aspiring agricultural teachers who went abroad for learning improved farming skills and new teaching techniques; other recruitments will be made. Such investments will generate very positive outcomes in the longer term as it would take quite some time for teachers to be in place, teach good agricultural practices to students, and for students to become good professionals who will enter the labour market for good extension services and farms development.

In the shorter and medium terms, it would be useful to teach the existing teachers of TVETs and expose them to new teaching approaches including living lab and new technologies so that they improve the level of agricultural practices that are taught to students. Skills needed may concern soil and water management techniques, design of irrigation schemes, nutrients determination for plants and fertilization schemes, post-harvest handling techniques, and farm and cooperatives management. A similar situation is also needed at tertiary level as university lecturers also need capacity building in new teaching approaches. Tailor Made Training (TMT) opportunities of Orange Knowledge Programme (OKP) are there for that purpose, where Dutch lecturers in combination with local/regional experts can provide/exchange specific knowledge with local teachers.

Knowledge to business. This strategy requires that relevant and regular meetings are organized per region by regional development agencies (e.g., ATDA) to improve collaborations between agri-businesses and innovators/researchers. That would improve innovations testing and adoption by these agri-businesses to improve their business; a real contribution of research to development. Such a knowledge sharing space has recently started by ATDA7 in South Benin where relevant stakeholders (public, private, NGOs, academia) met to discuss possibilities of collaboration and how each actor can contribute to the vegetable sector.

Furthermore, even if it is expected that new and well-educated professionals can enter the sector in the future, it is important to improve the capacities of existing farmers cooperatives in their transition into good agricultural practices. In general, farmers engage in cooperatives to leverage the potential of cooperatives in accessing more market opportunities, reducing transaction costs, and making economies of scale. However, most of these cooperatives do not know what cooperating actually entails, and how to find and secure market opportunities.Therefore, it is important to professionalize farmers cooperatives. Indeed, although most farmers belong to a cooperative, the low cooperation among them also justifies the difficulty to sustainably improve their agricultural practices and easily aggregate their products. While this situation is generally due to low education level and competence and lack of trust, it is necessary to smoothly professionalize their cooperatives by driving them through a series of trainings and networking. The Agribusiness Market Ecosystem Alliance (AMEA) may be helpful in accelerating farmers cooperatives professionalisation.

Appendices

Annex 1:

Stakeholders interviewed during the study

Type of actor	List of actors

Vegetable's producers	• 17 producers including:
	  • 5 farmers from the north (Malanville, Karimama)
	  • 12 farmers from the south (Cotonou, Sakété, Seme-Kpodji, Kpomasse)
	  • 12 men
	  • 5 women
	  • 8 youth (< 35 years old)
	  • 9 adults (>35 years old)

Vegetable's processors	• 10 processors including:
	  • 3 processors from the north (Malanville, Karimama)
	  • 7 processors from the south (Cotonou, Abomey-Calavi, Porto-Novo)
	  • 5 men
	  • 5 women
	  • 4 youth (< 35 years old)
	  • 6 adults (>35 years old)

Vegetable's traders/exporters	• 10 traders/exporters including :
	  • 3 traders/exporters from the north (Malanville, Karimama)
	  • 7 traders/exporters from the south (Cotonou, Abomey-Calavi, Kpomasse)
	  • 5 men
	  • 5 women
	  • 4 youth (< 35 years old)
	  • 6 adults (>35 years old)

Vegetable's consumers	• 8 consumers (restaurants, hôtels, households) including :
	  • 3 restaurants and hotels from the north (Parakou)
	  • 5 restaurants, hotels, and households from the south (Abomey-Calavi, Cotonou)
	  • 2 men
	  • 6 women
	  • 4 youth (< 35 years old)
	  • 4 adults (>35 years old)

Type of actor	List of actors
Support actors	• East West Seeds • Holland Green Tech/Projet HortiBenin • Accueil Paysan • Africa Green Corporation • ALIDé • Bénin Semences • Les Primeurs du Bénin • Rijk Zwaan
Facilitation actors	• Agence Territoriale de Développement Agricole 7 • Fédération Nationale des Organisations de Maraichers • Union communale des maraichers de Cotonou • SNV/EJASA • Hortitechs Développement • Institut National des Recherches Agricoles du Bénin • Projet d'Appui au Développement du Maraîchage • IFDC/Projet 2scale • IFDC/Projet ACMA2 • ONG DEDRAS/Projet Drops4Crops • Laboratoire GBIOS • World Vegetable Center/Projet SAFEVEG

Annex 2:

List of vegetables commonly produced and consumed in Benin.

Fruit vegetables	Leafy vegetables	Root vegetables
Tomato	Lettuce	Onion
Chilli Pepper	Gboma eggplant	Carrot
Habanero pepper	Cabbage	Radish
Bell pepper	Crincrin (Corete)	Celery
Okra	Parsley	Beetroot
Watermelon	Amaranth	Leek
Melon	African basil (Scent leaves)	
Cucumber	Vernonia	
Green bean	Coriander	
Oriental (Brinjal) eggplant	Mint	
African Eggplant	Celosia	
Zucchini		
Pumpkin		

Annex 3:

Criteria for the prioritization of vegetables.

Criteria	Meaning	Sub-criteria
Commercial Potential (production, competitive advantage, market)	This criterion evaluates the current state of vegetables supply and demand, focusing on agroecological potential, local production, presence of farmers, import substitution potential, and existing markets.	Local market potential
		Regional and international market potential (market share, size)
		Import substitution potential
		Agro-ecological conditions, Production & Growth
Enabling Environment ie Business and policy environment, skills environment etc	This criterion assesses the suitability of the policy environment for business development by local and foreign investors, the ease of doing business, the importance of vegetables for policies, and the existing regulations and restrictions on the vegetables.	Enabling environment for business investments
		Previous and ongoing national and other foreign programs likely to facilitate new investments
		Strategic importance in national agricultural policies
		Absence of restrictions or distortionary policies
Dutch Know how & Strategic Interests	This criterion assesses the comparative advantages for Dutch companies, the ability for Dutch knowledge and technology transfer, and related previous and ongoing Dutch programs.	Ability for Dutch knowledge and technology transfer
		Competitive and comparative advantage for Dutch private sector
		Previous and ongoing Dutch programs that lower risks for new investments
Scope for intervention and impact potential	This criterion examines general challenges (inputs, postharvest, support services) faced by stakeholders, the potential impact on farmers, gender, and inclusion aspects (women and youth), and food security dimensions.	Challenges to access inputs (seed, fertilizer, pesticide, equipment)
		Challenges for Postharvest handling
		Challenges to access support services (credit, skills)
		Presence of small and emerging farmers
		Impact on women and youth
		Impact on food security (income, improved diets)

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