

Opportunities and Challenges for Local
Agricultural Machinery Manufacturers:

Insights from the Benin Republic

FRR VOLUME
6 No 01

Authors

Adegbola Y.P
Zossou S.R.C
Adegbola C

Tossavi B
Fatunbi A.O
Daum T



MAY 2022

Citation: Adegbola Y.P., Zossou S.R.C., Adegbola C., Tossavi B., Fatunbi A.O. and Daum T. (2022). Opportunities and Challenges for Local Agricultural Machinery Manufacturers: Insights from Benin Republic. FARA Research Report 6 (01): Pp 125

Corresponding Author

Adegbola Y.P

ISSN:2550-3359

Editorials

Mr. Benjamin Abugri (babugri@faraafrica.org)

FARA encourages fair use of this material. Proper citation is requested

Forum for Agricultural Research in Africa (FARA)

12 Anmeda Street, Roman Ridge PMB CT 173, Accra, Ghana Tel: +233 302 772823 / 302 779421 Fax: +233 302 773676 Email: Website: www.faraafrica.org : www.faradatainforms.faraafrica.org

Join the network: <https://faraafrica.community/fara-net/join>

Register as an AR4D expert: <https://experts.faraafrica.org/>

Designed By: Samuel Oti Attakorah - FARA Knowledge Management, Learning & Communications Unit (publications@faraafrica.org)

About FARA

The Forum for Agricultural Research in Africa (FARA) is the apex continental organisation responsible for coordinating and advocating for agricultural research-for-development. (AR4D). It serves as the entry point for agricultural research initiatives designed to have a continental reach or a sub-continental reach spanning more than one sub-region.

FARA serves as the technical arm of the African Union Commission (AUC) on matters concerning agricultural science, technology and innovation. FARA has provided a continental forum for stakeholders in AR4D to shape the vision and agenda for the sub-sector and to mobilise themselves to respond to key continent-wide development frameworks, notably the Comprehensive Africa Agriculture Development Programme (CAADP).

FARA's vision is to "Reduced poverty in Africa as a result of sustainable broad-based agricultural growth and improved livelihoods, particularly of smallholder and pastoral enterprises" its mission is the "Creation of broad-based improvements in agricultural productivity, competitiveness and markets by strengthening the capacity for agricultural innovation at the continental-level"; its Value Proposition is the "Strengthening Africa's capacity for innovation and transformation by visioning its strategic direction, integrating its capacities for change and creating an enabling policy environment for implementation". FARA's strategic direction is derived from and aligned to the Science Agenda for Agriculture in Africa (S3A), which is in turn designed to support the realization of the CAADP vision.

Disclaimer

"The opinions expressed in this publication are those of the authors. They do not purport to reflect the opinions or views of FARA or its members. The designations employed in this publication and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of FARA concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers".

Acknowledgements

The research is led by FARA, the Centre of Development Research (ZEF) and the University of Hohenheim and conducted by Dr. Ygué Patrice Adegbola, an independent consultant with collaboration of the staff from the Centre for Research and Training in Social Sciences (CIRFoSS) in Benin.

The authors are indebted to researchers in ZEF and FARA for the reviews of the proposals and the final outputs of the research endeavours. The contributions of Dr. Fatunbi Oluwole and his team in FARA are well acknowledged. We would like to express our gratitude to the staff of CIRFOSS, who played a great role in data collection and analyses and in the writing of this technical report. We would also like to thank all the enumerators, the interviewer, the mechanisation trainers, the representatives of different stakeholders. The authors are very grateful to Dr. Ahouansou Roger, Babio Abdul Karim, Vodounnou Edmond, Tanabou Assaf, Adjibi Lassisi, Sego Sounon, Guy Omer, Zokpodo Barnabe, Talon Abel, Saliou Abdou Karim, Tonhgodo Aristide, Biaou Phirmin, Heinrich Roth, for their cooperation and contribution during this study.

This study was developed in the context of the Program of Accompanying Research for Agricultural Innovation (PARI), supported by the Federal German Ministry for Economic Cooperation and Development (BMZ).



Introduction

Agricultural mechanization refers to the use of animal or mechanical power along the value chain, comprising crops such as grain, legumes, fruits, and vegetables as well as livestock and fish. African value chains are among the least mechanized of all continents (Daum & Birner, 2020). This is problematic since low levels of mechanization are associated with limited labour productivity (Fuglie & Rada, 2013) and a high labour burden, affecting in particular also women (Daum et al, 2020). According to the Malabo Montpellier Panel, the low levels of mechanization are a “main constraints to increasing domestic food supplies in Africa” (Malabo Montpellier Panel, 2018b, p. 8). However, with the re-emergence of agriculture on Africa’s development agenda, there is now a renewed interest in agricultural mechanization by governments across Africa (Daum & Birner, 2020).

Historical research, as well as contemporary research from Asia and Latin America, has shown that the local manufacture of machinery can play a key role in agricultural mechanization (Binswanger, 1986; Diao et al, 2020). In particular, as compared to the import of machinery, private market-led local manufacture may be better able to design and produce local-specific technologies as well as create meaningful jobs in rural areas. However, despite these opportunities, previous research has shown that local manufactures often face various challenges related to the production and marketing of their machinery. These include unreliable electricity supply, a lack of standards, and testing undermining the trust in local machinery, and tariff policies favouring the import of machinery (as described by Daum & Birner, 2017 for Ghana; FAO, 2020 and MAEP, 2017 for Benin).

This report identifies factors and actors influencing the success of local manufactures and explores the opportunities and challenges for the local agricultural machinery industry. The analysis is based on a mixed-methods approach. The approach is comprised of a quantitative survey among local manufacturers; a qualitative mapping exercise, called net-maps (Schiffer & Hauck, 2010) among local manufactures and other stakeholders, which helps

identify key actors and bottlenecks; and key informant interviews with stakeholders that are important for the success of local manufacturers, such as representatives from farmers and industry associations, regulatory bodies, financial institutions, and training institutions. The report provides policy recommendations on how to make local manufacturers thrive and increase their competitiveness, vis-à-vis machinery imports. The report identifies opportunities of mechanization policy and investments to increase productivity, incomes, and employment opportunities and value addition to African produce.

The work is part of the Programme of Accompanying Research for Agricultural Innovation (PARI), which has identified “mechanization and skill development for productivity growth, employment and value addition” as one of its top priorities. PARI is led by the Centre of Development Research (ZEF) and funded by the German Federal Ministry for Economic Cooperation and Development as part of the One World, No Hunger Initiative (SEWOH). PARI's research cluster on mechanization is led by the University of Hohenheim, the Forum for Agricultural Research in Africa (FARA) and ZEF, and is jointly implemented with the Institut National des Recherches Agricoles du Bénin (INRAB), Kenya Agricultural and Livestock Research Organization (KALRO), Agricultural Research Council of Nigeria (ARCN), Institut d'Economie Rurale (IER).

General information on the status of local manufacturing



To better understand the agricultural machinery manufacturing sector in Benin, it is necessary to review previous work in the local agricultural machinery manufacturing sub-sector. //

The Root and Tuber Development Programme (PDRT), in partnership with the Regional Initiative for the Processing and Marketing of Cassava (IRTCM) and the International Fund for Agricultural Development (IFAD), conducted a study in 2008 on the creation of a national database on manufacturers of cassava processing and derivative production equipment in Benin. This study showed that cassava processing equipment manufacturers had a strong presence in the cities of Porto-Novo, Bohicon, Ouidah, Parakou and Cotonou (IFAD, 2008). More than 42% of these manufacturers were in the informal sector, i.e. they were not known to the state and its competent services for possible support, and also for tax levies. Indeed, most of the local equipment manufacturers in Benin were simple craftsmen. The study also made it possible to identify the types of equipment produced

by these manufacturers according to each manufacturer's taste, choice and model, and their physical characteristics. These types of equipment were, among others, grater, mechanical press, fermentation tank, sieve, slicer, and rickshaw. With regard to these equipment, concerns about the general lack of standardization and standards (especially in terms of size and weight) were raised. For the adaptation of engines to the graters manufactured, the manufacturers surveyed used two types of engines (gasoline and diesel), the most frequently used being the 4-stroke gasoline engine with a 5 horsepower (hp) capacity. Some used 3hp and 7hp motors, depending on the size of the equipment.

For the model of equipment produced, manufacturers drew on their own experiences and other sources, mainly trade fairs and other manufacturers' models on site. Catalogues and the Internet were not much valued by manufacturers as sources of inspiration. However, it is important to keep in mind that the study is now more than 10 years old; some things may have changed. The study highlighted manufacturers' business policies and strategies, the main bottlenecks met by these manufacturers, and users' perceptions of the equipment purchased and used.

The promotion policy used was mainly focused on photo albums, sales exhibitions and trade fairs. Promotion through catalogues, flyers and especially websites was scantily used by manufacturers, probably due to lack of resources (human and financial) or knowledge of these channels. Again, it is

important to note that the study was in 2008, when ICTs and the Internet were much less common.

Sales to order, after-sales warranty, installation of the equipment sold and, if necessary, training of users acquiring equipment were assets, which manufacturers relied on to sell their products. Without equipment purchase insurance, a manufacturer does not commit to the production of the equipment desired by the user (IFAD, 2008; Dene, 2019). This is an indication of the limited market for cassava processing equipment into gari and other by-products, and perhaps also of the low purchasing power of potential users of this equipment. This is due to the relatively high production cost of this equipment, since, according to the manufacturers, the materials used in the manufacture of this equipment are becoming more and more expensive, without overshadowing the cost of electricity required for their production. These are also reasons why the manufacturers surveyed do not like to sell their equipment on credit. The cash sales policy, although consistent with the huge investments made by the manufacturer for the production of each piece of equipment, did not, however, meet the wishes and desires of the user, whose already meagre resources did not allow him to acquire the equipment on a cash basis. It should be noted, however, that most of these manufacturers, in the event of a sale, ensured that users had access to spare parts and made emergency repair interventions when necessary. Therefore, they granted users warranty periods ranging from three (03) to six (06) months, depending on the manufacturer.

One of the first difficulties that manufacturers face in the production of agricultural processing equipment is the low level of their working capital, which is unable to cover their needs for the purchase of basic materials for the manufacture of such equipment (IFAD, 2008; FAO, 2008). This situation justifies the fact that they are unable to make mass production at the risk of hoarding the machines only. In this case they risk that their insufficient working capital gets locked up in equipment that is waiting for a providential user who will still occasionally try to reduce the cost of the equipment as much as possible. Also, the already very low level of working capital does not even allow them to meet orders without an advance from the person requesting the equipment. In addition to these major constraints, other difficulties faced by manufacturers are related to the insufficiency of work tools and when they exist, they are mostly not adapted to the expressed needs of users; the scarcity of materials, particularly stainless steel materials and these raw materials when available are expensive; lack of skilled workers to assist in manufacturing; Poorly designed copy by informal manufacturers of models created by formal manufacturers; injuries due to lack of appropriate work tools.

In addition to difficulties related to production, manufacturers of agricultural equipment for processing cassava into gari and derived products are also faced with difficulties related to the sale of the equipment or materials produced (IFAD,

2008). One of the major difficulties is the non-repayment of sales on credit by users, and the corollary is the reduction or even loss of part of their already insufficient working capital. Another consequence of this situation is the minimization, by the users, of the cost of sale of the materials produced, because they do not know the expenses incurred by the manufacturer, even if the quality and usefulness of the product are known by them (IFAD, 2008; FAO, 2008; FAO, 2020). Other difficulties are in selling of the equipment or materials produced, the absence of subsidies to reduce the cost to users of the materials; cost of after-sales support that is too high and difficult for users to bear; unfair competition, scarcity of customers, non-compliance with contracts by customers; poor maintenance of equipment by customers; lack of resources for advertising; non-availability of means of transport during deliveries of materials or equipment purchased, to the point where they are forced to resort to cab hire, which is more expensive for them; and low profit margins.

Dene (2019) shows through his research in sub-Saharan Africa that several diagnostic results of cashew nut processing revealed difficulties in the mastery of processing technologies. Indeed, local promoters often make unsuitable technology choices and sometimes at high cost because of a lack of information. It shows that competitive processing requires production in quantity and quality at the lowest cost. Having and adapting high-performance equipment are a major challenge for local transformers.

A research by FAO (2020), conducted through the national strategy on agricultural mechanization in Benin, concluded that over the last ten years, efforts have been made to develop postharvest equipment for agricultural, animal and fishery products; this equipment is now available locally with major manufacturers. However, the equipment is not standardized or approved (IFAD, 2008; FAO, 2020). They also pointed out that the high level of mechanization in postharvest operations is linked to several aspects, including the large capacities of local manufacturers, who are well-equipped with infrastructure, machine tools and a skilled workforce.



Methods

Targeted respondents for the quantitative survey were local manufacturers. The selected sampling was stratified random, drawn out from the exhaustive inventory list of local manufacturers, obtained from actors who were involved in agricultural machinery manufacturing. These were knowledge and skills building institutions, policymakers (agricultural research institutes, Territorial Agency for Agricultural Development, Ministry of Industry, and Ministry of Agriculture), non-government organizations /TFP (technical and financial partners) and projects, local manufacturing organizations, farmers and transformer-based organizations.

From the list, the snowball method was used to increase the sample size using the social networks of the manufacturers on the list. The complete list showed that manufacturers were mostly in three (3) ADHs (4, 5, 7) out of the existing seven. These areas also represented areas of high use of manufacturing equipment and agricultural

product processing (IFAD, 2008; Havard and Gaudard, 2018).

For the quantitative survey, a selection of 50 local manufacturers was recommended. Thus, the total number of manufacturers sampled at the level of each ADH was calculated in proportion to their weight in each ADH, and also according to the type of manufacturer (private sector, domestically-owned; private sector, foreign-owned; and government/state-owned sector). There was only one private sector (foreign-owned) manufacturer and one government/state-owned manufacturer in Benin. They were purposively included in the sample. Subsequently, 10 manufacturers of ADH4, 18 of ADH5, and 22 of ADH7 were randomly selected from the Excel Spreadsheet (Table 1).

We assume that Y_n is the number of local manufacturers of ADH_n , with $n = \{4, 5, 7\}$.
number of sampled local manufacturers in the $ADH_n = 50 \times Y_n / \sum Y_n$

Table 1: Distribution of local manufacturers sampled by ADH

ADH	Type of local manufacturers	Number of manufacturers identified through census	Number of manufacturers sampled at the 3 ADH levels selected	Subcounties
4	Private sector, domestically-owned	21	10	Parakou, Glazoué, savalou, Savè, N'Dali
	Private sector, foreign-owned	0	0	
	Government-/state-owned sector	0	0	
Subtotal ADH4		21	10	
5	Private sector, domestically-owned	41	18	Bohicon, Zogbodomey, Dogbo
	Private sector, foreign-owned	0	0	
	Government-/state-owned sector	0	0	
Subtotal ADH5		41	18	
7	Private sector, domestically-owned	53	22	Calavi, Cotonou, Ouidah, Porto-Novo, Tori
	Private sector, foreign-owned	1	1	
	Government-/state-owned sector	1	1	
Subtotal ADH7		55	22	
Total All ADH		118	50	

The quantitative data were collected in December 2020, with an application loaded in a tablet that housed the numeric version of the individual questionnaire. Subsequently, the data collection agents were recruited and trained. A pre-test was carried out with the investigators, in order to refine the questionnaire. Four (04) controllers and two (02) supervisors carried out supervision mission to control the quality of data collected in the field. Descriptive analysis and statistical tests for comparing means and proportions were methods used to analyse the data.

| Net-Maps: Sampling of the actors surveyed

The target groups for the survey were local manufacturers of agricultural machinery, policymakers, experts from international or donor organizations, end-users (representatives of farmers and processors), and spare parts and raw materials providers. Stratified random sampling was carried out from the exhaustive inventory list of manufacturers of agricultural machinery, obtained during the qualitative survey in 3 ADHs (4, 5, 7) out of the existing seven. These ADHs were selected because they represent South, Central and North Benin, which are par excellence areas of production and use local agricultural machinery (IFAD, 2008; Havard and Gaudard, 2018).

For the survey, it was recommended that 10 local manufacturers be selected. Thus, the total number of manufacturers sampled at the level of each ADH was calculated in proportion to the weight of the manufacturers present in each ADH. Subsequently, two (02) manufacturers of ADH4, four (04) of ADH5, and four (04) of ADH7 were randomly selected from the Excel Spreadsheet (Table 2).

Y_n was assumed to be the number of local manufacturers of ADH_n , with $n = \{4,5,7\}$.

Number of sampled local manufacturers in the $ADH_n = 10 \times Y_n / \sum Y_n$

Policymakers and experts from international organizations or donors were selected randomly from the list of national and local government agencies, intergovernmental organizations, agricultural research centres, nongovernment organizations (NGOs), technical and financial partners (TFPs), and projects involved in manufacturing local machines all over the country.

Internet research, literature reviews, and discussions with producers and manufacturers associations, researchers, university professors, and institutional directors, were used to help identify the contact details of end-users (producers, tractor-owners, processors), raw materials and spare parts providers, and to make appointments for interview. In total, two policymakers, one expert from international or donor organizations, one from raw materials providers, two end-users of agricultural machines (processors and producer's association) were surveyed (Table 2). The qualitative survey was conducted from October to November 2020.



Table 2: Distribution of participants to the net-map

Categories of participants	ADH	Total number of manufacturers in each ADH	Number sampled	Total number of participants
Local manufacturers	4	21	2	3 – 6
	5	41	4	
	7	55	4	
Policymakers			2	2 – 3
Experts of NGOs/PTFs/Projects			1	5
Raw materials and spare parts provider			1	2
End users (producers, processors)			2	4
Total number of interviews			16	4

Data collection

Net-map is categorized as a participatory appraisal method and, therefore, relies on group interaction and visualization. The method was developed by Schiffer (2007) and is particularly suited for analysing the structure and functions of complex systems with multiple actors. A special feature of the Net-map tool is a focus on identifying how stakeholders influence particular outcomes within a wider system. Therefore, the tool was found to be particularly suitable for identifying the different actors influencing the success of local manufacturers, and assess their role in the mechanisation process. Another reason for using Net-map was that the tool is useful for analysing governance challenges. For example, Raabe et al. (2010) applied a version of Process Net-map to study the governance challenges of a social safety net programme in India. Daum and Birner (2017) applied Net-map technique to analyse the neglected governance challenges of agricultural mechanisation in Ghana. Ilukor et al. (2015) used this tool to investigate governance challenges of the provision of veterinary services in Uganda. Lubungu and Birner (2018) used it to analyse governance challenges on livestock vaccination campaigns in Zambia.

The Net-map procedure was applied as follows: In the first step, the participants were asked to discuss the following questions:

- a. Who are the stakeholders involved, and who directly or indirectly influence the manufacture of agricultural machinery, and what are their roles? The name of each stakeholder mentioned by the respondent was written by the interviewer on a small card with different colours and placed on a large sheet of paper. Then, the participants were asked to discuss the following question:
- b. How is collaboration carried out among stakeholders to determine the success of local manufacturers? Different types of linkages (e.g., advice and extension, transfer of competences, flows of information, money and goods/services) were indicated with arrows using different colours between the stakeholders. Different arrow heads in different colours were made for the same arrow to illustrate several links, to avoid cluttering the map. Thereafter, the participants discussed question (c):
- c. Who are the most important stakeholders influencing the success of these manufacturers? The level of importance of the stakeholders was represented by stars. The number of stars (represented on a scale of 1 to 10) increased according to the level of influence of the stakeholder, as perceived by the respondent. The stakeholders who were considered not to have any influence on the outcome were not assigned any star. The stars were placed next to actor cards. Respondents were asked to adjust stars as they deemed necessary during the interview and to verbally provide the reasons why different actors had the influence level attributed to them. The visualization of influence levels during the interview served as a useful tool to elicit information. Based on the map that was produced using this process, the participants discussed question (d):
- d. Were there bottlenecks between actors during the collaboration? How can bottlenecks be overcome in order to regulate the activities of local manufacturers? From the ten Net-maps with local manufacturers, end-users, raw materials and spare parts provider, the investigators generated an aggregated Net-map that was used during the subsequent policymakers and experts' interviews.

In addition, data triangulation and methods triangulation were used to ensure the credibility and confirmability of the results. The tools used for data collection were interview guide, post-it notes in different colours, A4 white-wide paper, pencils and felt-tip pens, eraser, ruler, notepad, and glue.

Data analysis

The different Process Net-maps for each component of the implementation process were combined using Visualizer programme to generate one complete map. The discussions held during the focus groups were transcribed and content analysis used to analyse and interpret them; this tool was also used to highlight trends at the level of participant categories (Hsieh and Shannon, 2005). Descriptive analyses were carried out in order to determine the proportion of actors determining the success of the manufacturers, and the main constraints. Averages of level of influence of each actor were calculated to know their strength in the manufacturing chain of agricultural machinery. To highlight the differences observed in the categories of participants, the statistical test of multiple comparisons of means was carried out.

Key informant interviews

The respondents for the key informant interviews were stakeholders that are important to the success of local manufacturers, as identified at the net-map sessions. Stratified random sampling was used to draw out the respondents from an inventory list of local manufacture organizations, knowledge and skills building institutions, policymakers (agricultural research institutes, territorial agency for agricultural development, ministry of industry, and ministry of agriculture), finance institutions (non-government organization/ TFP

and projects) and end users' organization.

About 30 key informant interviews were conducted using interview guidelines with stakeholders. Thus, the number of each type of stakeholders sampled was calculated in proportion to their weight. Subsequently, 7 stakeholders from knowledge and skills building institution, 6 from policymakers, 3 from financial institutions, 9 from local manufacture organizations, and 5 from end-users' organizations were randomly selected from the Excel Spreadsheet (Table 3).

Y_n was assumed to be the number of local stakeholders of organization or institution i :
number of sampled stakeholders of organization or Institution $i = 30 \times Y_i / \sum Y_i$

Table 3: Number of stakeholders interviewed in each type of organization or Institution

Type of organization or Institution	Number of stakeholders interviewed in each type of organization or Institution
Stakeholders from Knowledge and skills building institution	7
Policymakers	6
Finance institutions	3
Local manufacturer organization	9
End-users organization 5	5
Total	30

The discussions held during the key informant interviews were transcribed. Content analysis was used to interpret the contents of the qualitative data. During the interviews, the different roles, opportunities, and challenges stated were hierarchized, from the most important to the least important, by the stakeholders. Kendal's nonparametric method for assessing average rank was used to determine the average rank of roles, opportunities, and challenges related to local manufacturers of machinery, using SPSS statistic software.

Results

| Business background of local manufacturers

Table 4 presents the business background of local manufacturers. The Table shows that the dominant types of manufacturers (96%) in the field were in the private sector, domestically-owned. The average foundation year of farm equipment manufacturing firms is 14; and there was no statistical difference observed for the types of business. The majority of manufacturers surveyed (94%) were business founders/owners, except those in the foreign-owned private sector.

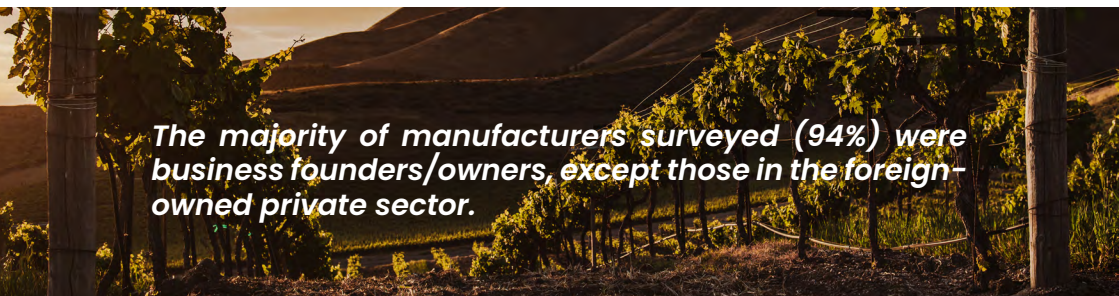
Considering the sample of respondents who were business founders/owners, the average age of the surveyed manufacturers was 43.27 years. The manufacturers were exclusively represented by men who had received training in welding (70%). More than half of the respondents had completed elementary education (57.45%). Only 19.15% had secondary school education. Those with master's degree (6.38%) who underwent vocational training (2.13%) were not many. Master's level was the highest education level held in the sector.

Moreover, less than half of the respondents (48.94%) had taken training in business administration, or accounting. More than half

(57.45%) of them owned or had been cultivating agricultural land. The majority of respondents (86%) became manufacturers out of passion/vision. The statistical differences observed showed that some became manufacturers because they had no other alternative /choice; others inherited the business (family / parental business).

When starting the business, manufacturers faced a variety of challenges. They considered lack of capital as the most daunting challenge (76%), followed by lack of access to production factors (38%), lack of machinery (24%) and an enabling environment (14%). Challenges related to lack of knowledge /skills (4%), land (2%) and market access (2%) were also raised.

Further, more than half of the manufacturing firms (58%) were officially registered, and 78% were part of an association or organization. Most of the manufacturers (about 84%) were located in villages or cities with a population of over 100,000. Some manufacturers in the private sector, domestically-owned (16.67%) were also located in villages or cities with a population of 50,000 to 100,000.



The majority of manufacturers surveyed (94%) were business founders/owners, except those in the foreign-owned private sector.

Table 4: Business background of local manufacturers

Type of business ownership	All manufacturers
Private sector, domestically-owned (%)	96
Private sector, foreign-owned (%)	2
Government-/-state-owned sector (%)	2
Foundation year of the business (in year)	14 (11.24)
Type of business ownership	100.00
Business founder/owner	94.00
Age (in year)	43.27 (9.43)
Gender	
Male	100.00
Female	0.00
Educational background	
Agriculture	10.64
Business administration / economics / marketing	0.00
Engineering	19.15
Welding	70.21
Others	0.00
Education level	
None	4.26
Elementary school level	57.45
Secondary school level	19.15
College	2.13
Undergraduate	4.26

Type of business ownership	All manufacturers
Certificate / diploma	4.26
Vocational training	2.13
Bachelor's degree	0.00
Master's degree	6.38
PhD	0.00
None	0.00
Others	0.00
Training on Business Administration, Business administration or Accounting	48.94
Farmland ownership	57.45
Reason to become a local manufacturer	
Dream / vision	86.00
Family/parental business	6.00
No alternative / choice	2.00
Others	0.00
Barriers faced at the beginning	
Lack of land	2.00
Lack of machinery	24.00
Lack of capital	76.00
Lack of knowledge / skills	4.00
Enabling environment	14.00
Lack of access to production factors (e.g. raw materials)	38.00
Lack of market access	2.00
Others	0.00
Business formally registered	58.00

Type of business ownership	All manufacturers
Business part of any association / organization	78.00
Business's location	
Village / city <10, 000 people ;	0.00
Village / city, between 10,000 and 50,000 people;	0.00
Village / city, between 50, 000 and 100, 000 people;	16.00
Village / city > 100, 000 people	84.00
<i>Note: Values in brackets (,): Standard deviation; Test: statistical test, ***, **, *: mean that each coefficient is significant at a threshold of 1% 5% 10% respectively</i>	

Design and Production

Table 5 presents information on the design and manufacturing of local equipment. Manufacturers used a variety of sources of ideas for equipment design. The majority (84%) copied designs from other manufacturers; 72% used their own ideas for the design; 52% simply used ideas or requests from their customers. Most manufacturers (68%) reported their involvement in research and development, and spent at least 4.35% of their annual revenues on this work.

To identify customer needs, 88.24% of the manufacturers conducted research and development through field experience. Less than half (46%) of them reported having

already invented or designed new types of machine.

Machines produced were used in various subsectors, of which the most important were: food processing and value addition (32.7%), construction (23.6%) (green infrastructure, such as clay and laterite bricks, laterite paving stones, vibrated tiles, foyers NANSU, water filters, artisanal refrigerators, oxygenators for fish ponds); and crop production and postharvest handling (21.98%). A minority produced for the subsectors related to animal production, processing and value addition (7.26%), forestry (6.5%), transport (6.5%) and horticultural production, processing and value addition (1.86%).

Table 5: Data on design and manufacturing

Categories	All manufacturers
Source of ideas for equipment design	
Own development	72.00
Copy from other manufacturers' models	84.00
Government agencies	0.00
Ideas / requests from Customers	52.00
Ideas / requests from employees	
Others	
Personal Research and Development (R&D) (R&D = work on innovation, introduction and product improvement).	68
Percentage of annual revenues spent on research and development	4.35 (2.77)
Identification of customer needs	
Surveys or focus group discussions	11.76
Field experiences	88.24
Others	0.00
Development of a new type of machinery or design of a type of machinery	46
Sectors for which the machinery is produced	
Crop production and postharvest handling	21.98 (26.75)
Food processing and value-added	32.7 (25.53)
Livestock (production, processing and value-added)	7.26 (10.61)
Horticultural (production, processing and value-added)	1.86 (5.12)
Construction	23.6 (21.71)
Forestry	6.5 (11.16)
Transport	6.5 (7.70)

Categories	All manufacturers
Others	0.00
Business formally registered	58.00

Production of equipment and benefits

Table 6 provides information on the aspects related to the marketing of equipment. Over the last three years, the equipment that sold the most were seed drill (56.8), mill (57.45) and shelling machine (56.07). The least sold equipment were fertilizer spreader (1.5), storage structure (2.00), sieve/strainer (6.55), incubator (6.625) and dryer (6.625).

Considering the last twelve months, the equipment most sold were direct seeder (26), mill (19.51), shelling machine (17.03), rake (10.59), harrow (9) and press (8). The least sold equipment, on the other hand, were fertilizer spreader (1.00), storage structures (1.00), incubator (2.12), calibrator (2.33) and clarifier (2.44). The differences observed showed that, compared to the last 3 years, there was decrease in the quantity of equipment currently produced and sold.

Table 6. Quantity of local equipment produced and sold in the last 12 months and the last 3 years

Quantity of local equipment produced and sold		
Number of equipment sold	In the last 3 years	In the last 12 months
Source of ideas for equipment design		
Power tiller	10.75 (12.09)	5 (4.08)
Plough	12.28 (16.65)	4.83 (5.11)
Sprayer	0.00	0.00
Harrow	31.00 (0.00)	9
Direct seeder	56.8 (83.26)	26 (37.10)
Fertilizer dispensers	1.5 (0.00)	1
Sprayer	0.00	0.00
Combine harvester	0.00	0.00

Quantity of local equipment produced and sold		
Number of equipment sold	In the last 3 years	In the last 12 months
Chopping machine	0.00	0.00
Mill	57.45 (103.66)	19.51 (35.56)
Shelling machine	56.07 (144.67)	17.03 (41.71)
Husker/ winnower	16.73 (34.91)	7.78 (18.35)
Storage structures	2.00 (1.41)	1
Cart/trailer	11.75 (16.27)	5 (6.08)
Irrigation pump	0.00	0.00
Generator	0.00	0.00
Packing machine	0.00	0.00
Steamer	9.08 (6.15)	2.63 (2.06)
Press	23.43 (29.33)	8.53 (13.66)
Crusher	24.55 (39.98)	8.88 (15.20)
Grating machine	23.28 (42.50)	10.59 (24.79)
Sieve/Strainer	6.55 (7.45)	2.66 (3.04)
Fermentation tank	8 (7.53)	2.83 (2.48)
Incubator	6.625 (3.42)	2.12 (1.12)
Dryer	6.625 (8.12)	3.5 (2.97)
Calibrator	8.75 (4.85)	2.33 (2.30)
Clarifier	7.22 (5.60)	2.44 (2.00)
Threshing machine	13.1 (20.75)	5.77 (9.39)
Improved woodstove	24.83 (19.41)	13.33 (17.13)
Parboiling kit (pot + rice parboiling tank)	11.33 (9.01)	7.66 (7.02)
Mixer	10.57 (8.88)	2.42 (1.51)
Others	15.33 (11.23)	8.9 (8.19)

In the last three years, the equipment with highest average prices were: the thresher-cleaner (FCFA 744,000 or 1,335.72 USD at a fixed exchange rate of 1 USD = 557 FCFA), storage structures (FCFA 450,000 or 807.90 USD) and husker-winnower (FCFA 425,263.2 or 763.48 USD) (Table 7). The equipment with the least average prices were fertilizer spreader (FCFA 150,000 or 269.29 USD), press (FCFA 188,439.7 or 338.31 USD), and fermentation tank (FCFA 210,666.7 or 378.21 USD).

Over the last 12 months, the most expensive equipment were power tiller (FCFA 1,575,000 or 2,827.65 USD), thresher-cleaner (FCFA 787,777.8 or 1,414.32 USD), calibrator and clarifier (FCFA 463,333.3 or 831.84 USD), storage facility (FCFA 450,000 or 807.90 USD) (Table 7). Those with low selling prices were fertilizer dispenser (FCFA 150,000 or 269.29 USD), plow (FCFA 175,833.3 or 315.67 USD), press (FCFA 192,031.3 or 344.75 USD), fermentation tank (FCFA 210,666.7 or 378.2 USD), incubator (FCFA 216,250 or 388.24 USD). The differences observed showed that the equipment whose selling prices increased were direct seeder, mill, cart/ trailer, steamer, press, crusher, sieve / strainer, dryer, calibrator, clarifier, thresher-cleaner, and kneader.

Table 7. Average prices of local equipment produced and sold in the last 12 months and last 3 years

Average price (in FCFA francs)		
	Last 3 years	Last 12 months
Power tiller	1825000 (236290.8)	1575000 (150000)
Plough	218571.4 (131235)	175833.3 (72966.89)
Sprayer	0.00	0.00
Harrow	420000 (0.00)	420000 (0.00)
Direct seeder	209000 (101882.3)	215000 (112583.3)
Planting machine	0.00	0.00
Fertilizer dispensers	150000 (0.00)	150000 (0.00)
Sprayer	0.00	0.00
Combine harvester	0.00	0.00
Chopping machine	0.00	0.00
Mill	248000 (120209.4)	252333.3 (161334.8)
Shelling machine	404615.4 (300189.7)	394259.3 (297420.7)
Husker/ winnower	425263.2 (244002.9)	382105.3 (272347.4)

Average price (in FCFA francs)		
	Last 3 years	Last 12 months
Storage structures	450000 (353553.4)	450000 (353553.4)
Cart/trailer	340000 (219545)	370000 (258650.3)
Irrigation pump	0.00	0.00
Generator	0.00	0.00
Packing machines	0.00	0.00
Steamer	292083.3 (119800.2)	300000 (128918.6)
Press	188439.7 (133657.7)	192031.3 (131749.1)
Crusher	398888.9 (210234.9)	410000 (220907.2)
Grating machine	282857.1 (203153.7)	261818.2 (213533.5)
Sieve/strainer	250555.6 (300067.1)	266666.7 (333391.7)
Fermentation tank	210666.7 (164636.2)	210666.7 (164636.2)
Incubator	216250 (113255.4)	216250 (113255.4)
Dryer	424375 (334551.3)	425000 (333734.3)
Calibrator	407500 (328975.7)	463333.3 (378989.9)
Clarifier	407777.8 (274398.3)	463333.3 (277668.9)
Thresher-cleaner	744000 (752628)	787777.8 (775141.6)
Improved woodstove	310000 (99398.19)	306666.7 (95219.05)
Parboiling Kit (pot + rice parboiling tank)	373333.3 (273191)	220000 (202237.5)
Kneader	340000 (89628.86)	342857.1 (93222.72)
Others (defibrator)	295833.3 (373194.5)	209500 (301979.1)

Over the last three years, the equipment with highest average production costs were the screening machine (FCFA 313,115.4 or 562.14 USD), husker/winnowing (FCFA 287,105.3 or 515.44 USD), cooker (FCFA 223,500 or 401.25 USD) and grating machine (FCFA 200,000 or 359.06). Among the equipment with lower average production costs were the press (FCFA 133,562.5 or 239.79 USD), incubator (FCFA 152,000 or 272.89 USD) and mill (FCFA 175,285.7 or 314.69 USD) (Table 8).

Considering the last 12 months, the threshing machine was the equipment that presented the highest production cost (FCFA 601,111.1 or 1079.19 USD), followed by calibrator (FCFA 363 000), clarifier

(FCFA 355,555.6) and crusher (FCFA 294,166.7 or 528.12 USD). Equipment with the lowest production costs were, among others, spreader (FCFA 100,000 or 179.53 USD), plough (FCFA 124,416.7 or 223.36 USD), press (FCFA 127,156.7 or 228.28 USD), direct seeder (FCFA 136,900 or 245.78 USD), incubator (FCFA 152,000 or 272.89 USD) and fermentation tank (FCFA 152,166.7 or 273.18 USD) (Table 8).

The differences observed show that the equipment whose production costs increased were direct seeder, husker/ winnower, cart/ trailer, crusher, sieve/ strainer, calibrator, thresher-cleaner, and improved woodstove.

Table 8. Average manufacturing cost for local equipment produced and sold in the last 12 months

Average manufacturing cost (in CFA francs)		
Average manufacturing price (in CFA francs)	Last 3 years	Last 12 months
Till	1175000 (170782.5)	1075000 (95742.71)
Plough	160928.6 (109499.8)	124416.7 (56480.45)
Sprayer	0.00	0.00
Harrow	294000 (0.00)	294000 (0.00)
Direct seeder	132900 (84258.83)	136900 (91926.87)
Planting machine	0.00	0.00
Fertilizer dispensers	100000 (0.00)	100000 (0.00)
Sprayer	0.00	0.00
Combine harvester	0.00	0.00
Chopping machine	0.00	0.00
Mill	175285.7 (111960.8)	174487.2 (123249.8)
Shelling machine	313115.4 (254862.2)	302259.3 (252373.6)
Husker/ winnower	287105.3 (188527.3)	382105.3 (272347.4)
Storage structures	325000 (247487.4)	325000 (247487.4)
Cart/trailer	256000 (179992.6)	274666.7 (215651)
Irrigation pump	0.00	0.00
Generator	0.00	0.00

Average manufacturing cost (in CFA francs)		
Average manufacturing price (in CFA francs)	Last 3 years	Last 12 months
Packing machines	0.00	0.00
Steamer	223500 (93700.2)	221545.5 (105746.3)
Press	133562.5 (99200.01)	127156.7 (102733.4)
Crusher	281944.4 (148553.2)	294166.7 (155792.6)
Grating machine	200000 (137849.6)	184545.5 (145405.1)
Sieve/strainer	154444.4 (185732.4)	176111.1 (220521.8)
Fermentation tank	153833.3 (121037.9)	152166.7 (118499.6)
Incubator	152000 (86605.84)	152000 (86605.84)
Dryer	283000 (230844.4)	283000 (230844.4)
Calibrator	309750 (294075.2)	363000 (335718.6)
Clarifier	376666.7 (284473.2)	355555.6 (241252.5)
Thresher-cleaner	582000 (509352.5)	601111.1 (535827.5)
Improved woodstove	231333.3 (78757.01)	233000 (79586.43)
Parboiling Kit (pot + rice parboiling tank)	286666.7 (213853.5)	179333.3 (193290.8)
Kneader	251428.6 (81940.75)	251428.6 (81940.75)
Others (defibrator)	208833.3 (267490.1)	146600 (218665.8)

The equipment that manufacturers had high profits on in the last three years were: power tiller (FCFA 650,000 or 1166.96 USD, at a fixed exchange rate of 1USD to 557 FCFA), thresher-cleaner (FCFA 162,000 or 290.84 USD), dryer (FCFA 141,375 or 253.81 USD), husker/ winnower (FCFA 138,157.9 or 248.03 USD), and harrow (FCFA 126,000 or 226.21 USD). Those with low benefit were clarifier (FCFA 31,111.11 or 55.85 USD), fertilizer dispensers (FCFA 50,000 or 89.76 USD), press (FCFA 54,877.19 or 98.52 USD), fermentation tank (FCFA 56,833.33 or 102.03 USD), and plow (FCFA 57,642.86 or 103.48 USD) (Table 9).

The equipment whose manufacturers had high profits over the last twelve months were power tiller (FCFA 500,000 or 897.66 USD), thresher-cleaner (FCFA 186,666.7 or 335.12 USD), dryer (FCFA 142,000 or 254.93 USD), harrow (FCFA 126,000 or 226.21 USD), and storage structure (FCFA 125,000 or 224.41 USD). Those with low benefits were parboiling kit (FCFA 40,666.67 or 73.01 USD), fertilizer dispensers (FCFA 50,000 or 89.76 USD), plow (FCFA 51,416.67 or 92.31 USD), fermentation tank (FCFA 58,500 or 105.02USD), and defibrator (FCFA 62,900 or 112.92 USD). The differences observed show that the equipment with increases in profit were direct seeder, mill, shelling machine, cart/ trailer, steamer, press, fermentation tank, dryer, calibrator, clarifier, thresher-cleaner and kneader.

Table 9. Average benefits in the last 3 years and the last 12 months

Average benefits (price sold – manufacturing costs) (in CFA francs)		
Average manufacturing price (in CFA francs)	Last 3 years	Last 12 months
Power tiller	650000 (251661.1)	500000 (141421.4)
Plough	57642.86 (22669.21)	51416.67 (17059.94)
Sprayer	0.00	0.00
Harrow	126000 (0.00)	126000 (0.00)
Direct seeder	76100 (45453.82)	78100 (46427.9)
Planting machine	0.00	0.00
Fertilizer dispensers	50000 (0.00)	50000 (0.00)
Sprayer	0.00	0.00
Combine harvester	0.00	0.00
Chopping machine	0.00	0.00
Mill	72714.29 (33196.01)	77846.15 (65845.73)
Shelling machine	91500 (78051.91)	92000 (77528.65)
Husker/ winnower	138157.9 (116418.9)	107631.6 (179059)
Storage facility	125000 (106066)	125000 (106066)
Cart/trailer	84000 (45284.29)	95333.33 (48013.89)
Irrigation pump	0.00	0.00
Generator	0.00	0.00
Packing machines	0.00	0.00
Steamer	68583.33 (57243.43)	78454.55 (50776.69)
Press	54877.19 (41685.47)	64874.53 (45882.33)
Crusher	116944.4 (88269.96)	115833.3 (87215.93)
Grating machine	82857.14 (93535.71)	77272.73 (93550.69)
Sieve/strainer	96111.11 (117998.4)	90555.56 (124685.7)
Fermentation tank	56833.33 (45446.31)	58500 (47060.6)

Average benefits (price sold – manufacturing costs) (in CFA francs)		
Average manufacturing price (in CFA francs)	Last 3 years	Last 12 months
Incubator	64250 (32185.84)	64250 (32185.84)
Dryer	141375 (117294.4)	142000 (116505.1)
Calibrator	97750 (35780.58)	100333.3 (43362.81)
Clarifier	31111.11 (149033.9)	107777.8 (58046.92)
Thresher-cleaner	162000 (309831.5)	186666.7 (313328.9)
Improved woodstove	78666.67 (38815.8)	73666.67 (37425.48)
Parboiling Kit (pot + rice parboiling tank)	86666.67 (81445.28)	40666.67 (10066.45)
Kneader	88571.43 (23401.26)	91428.57 (23401.26)
Others (defibrator)	87000 (117289.4)	62900 (93249.31)

Renewable energy machinery

Information on renewable energy machine production, demand, equipment certification, and record keeping is presented in Table 10. The sector that manufactured renewable energy machines was not well developed. Only a few manufacturers (8.00%) produced renewable energy dryers. The reasons for not manufacturing renewable energy machines were mainly related to lack of knowledge/skills (32.61%), lack of demand (30.43%), and lack of suitable machines/materials/equipment (21.74%).

Table 10. Renewable energy machines

Categories	All manufacturers
Share of manufacturers producing renewable energy machines	8.00
Type of renewable energy machines produced Dryer	100.00
Others	0.00
Reasons for not manufacturing renewable energy machines	
No knowledge / skills	32.61 (15)
No demand	30.43
No machines / materials / equipment	21.74
Not feasible	6.52
Never had the idea	8.70

Demand for equipment certification and record keeping

More than half of the surveyed manufacturers (56.00%) produced equipment mostly on demand (Table 11). Those who produced regularly and on demand (mixed production) were about 38%. The main reasons for producing on demand were the willingness to reduce market risks (66%), capital shortages (48%), and adapting the construction of equipment to demand and customer preferences (44%).

The majority of manufacturers reported compliance with standards related to the manufactured equipment. These standards

were related to the training received during apprenticeship. Formally, not all machines sold were officially tested and certified by a state agency. The majority of manufacturers (92%) offered warranty services on all marketed products. The same trend was observed for after-sale service.

More than half of the manufacturers (54%) rarely kept records, while 12.50% always kept records or had an accounting system. In contrast, only 14% of the manufacturers maintained or had registers or accounting systems.

Table 11. Demand, equipment certification, and record keeping

Categories	All manufacturers
Regular or on-demand production	
Regularly	6.00
On demand	56.00
Mixed	38.00
Others	0.00
Reason for production on demand	48.00
Lack of capital	
Reduce market risks	66.00
To adapt the construction of the equipment to the demand and preferences of the customers	44.00
Others	0.00
Compliance with standards	78.00
Certification of the machines sold	
Yes, all mostly	0.00
little	0.00

Categories	All manufacturers
No	100.00
Officially tested machines	
Yes, all mostly	0.00
little	0.00
No	100.00
Name of the agency that officially tests the machine	
Level of satisfaction with the agency's work	
Totally	
Mostly	
In one way or another	
Not really	
Not at all	
Product warranty offer	
Yes, all	92.00
mostly	6.00
little	2.00
No	0.00
Provision of after-sales services	98.00
Number of times of records or accounting system keeping	
Always	14.00
Most of the time	20.00
Rarely	54.00
Never	12.00

More than half of the manufacturers (54%) rarely kept records, while 12.50% always kept records or had an accounting system. In contrast, only 14% of the manufacturers maintained or had registers or accounting systems.

Marketing and customers

Table 12 shows the marketing and customer aspects of the different businesses. The data show that manufacturers mostly did their advertising through word of mouth (74%), showrooms (46%) and social networks (30.00%). The main clients of the manufacturers were processing businesses (21.9%), followed by large producers with an area of more than 15ha (18.20%), small producers with an area of less than 2ha (15.24%), cooperatives (14.9%), and public organizations (12.9%). The clients were mostly located in the same village/city (29.5%), outside the district/sub-county but within the country, and outside the district /sub-county but within the region/country (25%). However, only 3.10% of the clients were outside the country but within Africa.

The method of payment used by majority of the customers for on machine purchase was cash payment and bank transfer (42%). Before starting the design of a machine, the customer paid in advance. Only a few manufacturers (4.00%) did not considered advance payment as necessary. They did not mind selling machines on credit (26.00%), and about 10% could not satisfy all the requests for machines from customers in the previous year. The main competitors of manufacturers were in the village/city/ district/sub-county area (59.8%), and those outside the area but within the country, and machine importers (less than 20%).

The local manufacturers considered that they had advantage over machine importers. The advantage was mainly related to quality, local adaptation and after-sale service. Certain manufacturers added price (46.00%), availability, reputation and trust (less than 12%). The number of competitors of manufacturers was 18.

As regard the marketing of products (machines/equipment), the majority of manufacturers (96%) sold at the level of workshops; only 4.00% diversified by selling their products through sales networks. More than half of the manufacturers made more profits, after the sale of equipment, from business investments (55.3%) and private use (39.3%).



Table 12. Marketing and customers

Categories	All manufacturers
Means used for advertising the business	
Machines shows	14.00
Prize winning competition	2.00
Newspapers	6.00
Radio	4.00
Social networks	30.00
Word of mouth	74.00
Extension system	6.00
Showroom	46.00
Retailers Network	6.00
Others	0.00
Main customers	
Small producers (<2ha)	15.24 (2.72)
Medium-sized Producer (2-15ha)	12.26 (1.54)
Large producers (> 15ha)	18.2 (2.75)
Cooperatives	14.9 (2.15)
Processing businesses	21.9 (3.62)
Retailers	4.2 (1.51)
Public organizations	12.9 (2.92)
Customer location	
In the same village / city	29.5 (3.81)
Outside the same village /city within in the district/ subcounty	19.7 (2.15)
Outside the district/subcounty but within the region /country	24.6 (3.00)
Outside the district/ subcounty but within the country	24.7 (3.01)
Outside the country but within Africa	3.1 (0.81)
Customers' payment method	
Often in cash	100.00
Often in electronic payment	-

Categories	All manufacturers
Often in kind	10.00
Bank transfer	42.00
Others	
Payment of an advance by customers before production	96.00
Sale on credit to the customer	26.00
Satisfaction of all the customer demand for purchase of machine last year	90.0
Main competitors	
Manufacturers from area (village / city / district/ subcounty)	59.8 (4.49)
Manufacturers outside the area but within the country	15.6 (2.58)
Manufacturers outside the country but within Africa	1.4 (0.57)
Machine Importers	15.1 (2.43)
Government programmes	6.3 (1.36)
Perceived advantages over machine importers	
Price	46.00
Quality	78.00
Availability	12.00
Local adaptation	50.00
After sale service	44.00
Reputation / Brand / Trust	14.00
Others (Delivery time)	4.00
Amount of competing local manufacturers in the area (village / city / district/subcounty)	18.00
Means of selling the equipment produced	
At the Workshop level	96.00
Retailer Network	4.00
Others	0.00
Use of potential profits from the sale of the equipment produced	
Private use	39.3 (2.74)
Investment in business	55.3 (2.94)
Other (Savings, Bank)	2.4 (1.77)

| Employees, knowledge and skills

Table 13 presents data on the level of knowledge and skills of employees in the different subsectors covered by the study. The average number of people employed was estimated at five (5), which was an increment from the three (3) about three years before. The majority of employees had not received any training (72%). Those who had specific training were 22% for welding, 8% for engineering, and 4% for agriculture and business administration/economics/marketing.

The business of machine manufacturing had employees with elementary education (48%) and secondary school (26%) levels; those not educated were 36%. Moreover, many of the manufacturers were not satisfied with the knowledge/skills of staff hired directly out of school. Only 6% were mostly satisfied. Those who were not satisfied believed that practical classes, and school curricula and number of teachers must be upgraded/ increased in the educational system to meet the needs and requirements of the labour market.

Trainees were predominantly identified through a formal application process, and informal requests from prospective trainees. About 16% of the manufacturers accepted informal requests from parents /guardians. The average training duration was 4.06 months, while the average number of trainees was 11; the trainees did not receive any remuneration. In terms of collaboration in hands-on training, less than half of the businesses collaborated with vocational schools. At the end of their internship, trainees mostly went to work for other businesses (58%), or start their own business (16%).

Table 13. Employees, knowledge and skills

Categories	All manufacturers
Number of people currently employed	4.64 (6.34)
Number of people employed three years ago?	2.94 (3.52)
Employee's educational background	
Agriculture	4.00
business management/economics/marketing	4.00
Engineering	8.00
Welding	22.00
Others (No training)	72.00
Education level of employees	
None	36.00
Primary school	48.00

Categories	All manufacturers
College	26.00
Secondary school	4.00
Undergraduate	2.00
Certificate/Diploma	6.00
Professional training	6.00
Bachelor degree	8.00
Master	2.00
Doctorate	0.00
Others	12.00
Level of satisfaction with the knowledge/skills of staff hired directly after graduation	
Totally	2.00
Mostly	6.00
In one way or another	30.00
Not really	14.00
Not at all	48.00
Views on the evolution of education systems to meet the needs and requirements of the labour market	
More practice	92.00
More theory	0.00
Better teachers	4.00
Update programmes	4.00
Others	0.00
Practical training offer	
Means of identification of trainees	
Collaboration with the training institution	58.00
Formal application procedure	64.00
Informal application from trainees	30.00
Informal application from parents/guardians	16.00
Others	0.00
Duration of training (in months)	4.06 (2.20)
Salary offer to the trainee	0.00

Categories	All manufacturers
Number of trainees trained in the last three years	11.06 (11.79)
Collaboration with vocational schools to get the trainees	44.83
Opportunities for trainees at the end of the vocational training	
Self-employed	4.00
Create my own business	16.00
Works for another business	58.00
Others	0.00

| Enabling business environment

Table 14 presents the sources of financing and the business environment. In order to support their businesses, only 25% of manufacturers had applied for a loan/credit. They reported having applied for loans/credits in the last 3 years to purchase raw materials (58.33%), and equipment/machinery (41.67%). The majority of manufacturers (48%) did not apply for a loan because they felt they did not need one or that the application process was tedious (44%), or because of unsuitable repayment schedules (14%). About 14% others doubted whether they ever took a loan.

Of those who applied for loans, the majority (91.67%) received credit at an average annual rate of 8.27%. Of those who received credit, 72.73% received it from microfinance institutions. A small proportion (less than 10%) received credit from commercial banks, their friends or family, private lenders, non-government or faith-based organizations. Those who did not receive the requested credit were not satisfied because of the lack of guarantee.

About 60% of the businesses did not received any support from the government in the last 3 years. Of those who received government support, 36% got support for knowledge and skills development. Other types of support provided were loan/credit (2%); and machinery/equipment, land, factory building, free or subsidized electricity (4%). Only 16% of the manufacturers reported receiving support from donors in the past 3 years.

Almost all businesses (96%) had access to the electricity grid, and nearly 88% paid taxes last year. Also, 78% of them were affected by policies and regulations. They were most affected by local or domestic taxes (48.00%), environmental regulations (44%), and government competition (e.g, government machinery imports) (14%).

The lack of access to production factors (56%), to financing (44%) and machinery/equipment (48%); financing cost (32%), inadequate market access (28%), personal injury due to lack of appropriate work tools (20%) were the highest constraints to the business of machine manufacturing. Other limiting factors, although in small proportion, were: electricity cost, low purchasing power of buyers

and import regulations (less than 16%), lack of certification standards (12%), inadequate access to quality staff (10%), non-payment of credit sales and lack of resources for advertising (4%), unstable electricity, inadequate access to land, and low capacity (2%).

The majority of manufacturers rated the business climate as bad. Only 10% of them said that it was good, while 2% rated it as excellent. Over the last three years, the business environment was considered somewhat worse (28%). Only 6% noted that there was indeed improvement, while less than 22% felt that the improvement was little or insignificant; 16% felt that it had stagnated, and 28% felt it was worse.

Table 14. Sources of Financing and the Business Environment

Categories	All manufacturers
Loan/credit application to support the business in the last 3 years	25.00
Reasons for applying for credit	
Purchase equipment/machinery;	41.67
Buy raw materials;	58.33
Employee Salary	0.00
Buying land	0.00
Build a workshop	0.00
Others	0.00
Reasons for not applying for credit	
I didn't think I could get it	12.00
Prefer other sources	14.00
Tedious application process	44.00
Strict repayment schedule	14.00
Others (Not required)	48.00
Credit application accepted	91.67
Credit application denied	
Lack of warranty	100.00
No savings	0.000.000.000.00
Lack of a business plan	9.09

Categories	All manufacturers
No reason given	
Others	
Share of manufactures who have received loans/credit from the following organizations (Several answers are possible)	
Friends or family	
Private lender	9.09
Commercial bank	9.09
Microfinance institution	72.73
Non-governmental or faith-based organization / church	9.09
Government	0.00
Others	0.00
Interest rate (%) per year Support received from the government over the past three years?	8.27 (4.56)
Loan / credit	2.00
Free or subsidized machinery/equipment, land, factory building, electricity	4.00
3 = Knowledge and skill development	36.00
Others (No support)	60.00
Donor support over the past 3 years	16.00
Access to the electrical grid	96.00
Payment of taxes last year	88.00
Existence of policies and regulations that negatively affect the business	78.00
Clarification of policies and regulations that negatively affect the business	
Import regulations	10.00
Environmental regulations	44.00
Government competition (e.g. government imports of machinery)	14.00
Local or domestic taxes	48.00
Others	0.00

Categories	All manufacturers
Factors that limit the success of the business	
Access to / reliability of electricity	2.00
Electricity costs	16.00
Access to financing	44.00
Financing costs	32.00
Access to production factors	56.00
Access to qualified personnel	10.00
Lack of standards and certification	12.00
Import regulations	16.00
Access to land	2.00
Cost of land	
Access to machines / equipment	48.00
Peace and stability	
Market access	28.00
Model faking	14.00
Personal injury due to lack of proper work tools	20.00
non-repayment of credit sales	4.00
low purchasing power of buyers	14.00
Lack of resources for advertising	4.00
Capacity Building	2.00
Others	0.00
All stakeholder's perception of the business climate	
Excellent	2.00
Good	10.00
Fair	22.00
Pretty bad	12.00
Bad	38.00
Very bad	16.00
Level of evolution of the business environment in the last three years	

Categories	All manufacturers
Significantly improved	6.00
Little improvement	22.00
Stagnated	16.00
A little worse	28.00
Worst	28.00

Additional challenges and opportunities

Table 15 presents data on the different opportunities and challenges in local agricultural equipment manufacturing. The data show that the main challenges identified were related to technical support through the organization of capacity building and workshop to improve the quality of performance of the equipment produced; financial support through the provision of microcredit and subsidies for the purchase of modern tools and raw materials; and promotion of local equipment by the state and NGOs. For opportunities, the issues identified were related to:

- Promotion of the manufacturing of machinery using renewable energy,
- Creation of specific centres for the sale of raw materials and quality work tools,
- Use of stainless steel for the production of food processing equipment
- Establishing an association of formal and informal manufacturers to facilitate knowledge sharing,
- Creating innovations for meeting existing needs, and accessing credit,
- Import of specific machinery to serve as models for local manufacturers, so as to make copies that can be adapted to local contexts, and
- Establishing research programmes in the subsector.

Table 15. Opportunities and challenges related to the manufacturing of local agricultural equipment

Categories	All local manufacturers
Technical and financial support State and NGO promotion	42.00
Organization of the manufacturers	16.00
Promote after-sales services	12.00
Use of stainless steel for food processing equipment	8.00
Creation of specific centres for the sale of raw materials and quality work tools	6.00
Import of specific imported machinery that can be used as a model	6.00
Creation of research programme	6.00
Promotion of the manufacturing of machinery using renewable energy	4.00

Results from net maps sessions

Presentation of the actors involved in the manufacture of agricultural equipment and their roles

A variety of actors were directly and indirectly influencing the manufacture of agricultural machinery in Benin. Indeed, each of these actors played a well-defined role that contributes to the development of the subsector. These actors identified were:

- **Associations of manufacturers of agricultural machinery:** These are manufacturers who operate mainly in the informal sector; they often do not get government attention or support, but are monitored for the purpose of taxes and levies. They are the main actors in the manufacture of agricultural equipment in Benin. Indeed, the role of members of these associations is to produce agricultural equipment to meet the needs of local users (producers, processors, livestock breeders, etc). They are thus critical to the development of agricultural mechanization in Benin through their value-added services in local production.
- **Large private equipment manufacturing companies:** this group comprises large private companies specialized in the manufacture of agricultural equipment, such as COBEMAG , Benin tractors and Songhai Project. The role of these companies is to design and produce agricultural equipment to meet the demand in the agricultural world. This way, they contribute to the development of agricultural mechanization in Benin.
- **End users:** These include producers, processors, farmers, livestock breeders, producer or processor groups, etc. Their major role is the purchase and use of agricultural equipment produced by local manufacturers.
- **NGOs/PFP members, Intergovernmental organizations, projects:** This group was also identified by all categories of respondents (Table 16). Nongovernment Organizations (NGOs) and technical and financial partners (TFPs), such as DEDRAS , REDAD , Helvetas , GIZ , Enabel , and AgriPro Focus Benin; Intergovernmental organizations (FAO , UNDP , UNICEF) as well as projects (PAIA-VO , PASDER , PROCAR , PADA , PPAO , PAPVIRE-ABC , PADAC , FIDEFI , ACMA , TAZCO , etc.) have the role of providing technical support, funding and facilitation of market access through calls for tenders in the development of agricultural mechanization in Benin.
- **Intermediaries:** This group comprises everyone or group in the field that is interfacing between machinery/ tools produced and the end-users (NGOs, companies, producers, processors, groups, etc). The role of intermediaries is related to market research and facilitating market access.
- **Policymakers from national government:** The MAEP, the Ministry of Interior, the MESTFP , SME-MICPE , etc. are also much involved in the local manufacture of agricultural equipment. Indeed, the role of these national government bodies is to provide technical and financial

support (project funding) to manufacturers to enhance agricultural mechanization in Benin. They mainly support groups of processors and producers by supplying equipment ordered from local manufacturers via calls for tenders.

- **Policymakers from local government agencies:** Policymakers, such as ATDA and DDAEP are involved in the local manufacture of agricultural equipment. Indeed, the role of these local government bodies is also to ensure the development of agricultural mechanization through training, advice-extension and the sale of agricultural equipment.
- **Scientists from research organizations:** Scientists from research organizations (INRAB , PTAA-INRAB , CRA-INRAB , University, IITA , ABREVIT) are also involved in the sub-sector of local manufacturing of agricultural equipment according to all the categories of actors met except for raw material suppliers (Table 16). Indeed, the role of these scientists is to conduct scientific research activities for the development of agricultural mechanization in Benin. They work in partnership with national government agencies which support them financially and technically in their various activities. They also inform the Government in certain Policymaking processes related to this sub-sector.
- **Tax collection agencies:** Town councils and the tax departments are involved in local agricultural equipment manufacturing, according to all the categories of actors interviewed. While the role of tax departments is to ensure the collection of fees and taxes from local manufacturers, town councils play the role of local development through facilitating the establishment of structures for, and collaborations between NGOs and manufacturers.
- **Microfinance institutions (CLCAM , PADME , PAPME , BOA , etc.):** All the categories of actors interviewed identified microfinance institutions (MFIs) as being involved in the local agricultural equipment manufacturing subsector. Their role is to provide credit to direct actors (manufacturers, mechanics, spare parts sellers, etc.) in the production of agricultural equipment.
- **Raw materials providers (hardware store, etc.):** This group, which includes hardware stores, and importers of spare parts, is among the main actors of the local agricultural manufacturing equipment subsector. Their role is to ensure the steady supply of raw materials (spare parts, etc.) for the production of agricultural equipment.
- **Trainers or teachers in agricultural institutions:** Trainers or teachers in private and public training centres (Songhai Project, CPU-EPAC , universities and other schools) are also major players in the subsector. Their role is to train, refresh and build the capacity of stakeholders in the design, production and use of agricultural equipment. They also send their students to manufacturers' workshops for practical internships.
- **Students/learners:** Students or learners were also identified by respondents as major players

in the subsector. Their role is to design equipment on the basis of theoretical and practical knowledge received in training centres. They also participate in training/ retraining or capacity building on the manufacture and use of agricultural equipment.

- **Machine dealers or resellers:** Agricultural machinery dealers or resellers are involved in the local manufacture of agricultural equipment—this was affirmed by all the categories of respondents, except the end-users. The data show that their major role is the purchase and sale of local and imported agricultural equipment, as well as spare parts of such equipment.
- **Welders/ sheet metal workers, electricians, painters, turners, scrap metal workers, mechanics:** This group of actors is also critical to the local agricultural equipment manufacturing. Their role is mainly to collaborate in the manufacturing process by carrying out tasks that fall within their expertise. They also take care of equipment maintenance by making repairs and assemblies to end-users.
- **Importers of machines and spare parts:** Importers of agricultural machinery and spare parts are involved in the local manufacture of agricultural machinery, performing the role of import and sale of such machines and their parts. This sector is generally dominated by the Chinese.
- **Subcontractors (formal private companies and firms):** formal private companies and firms were specifically identified by local manufacturers as being important to the subsector. Their role is to win contracts from government, NGOs, etc. on the manufacture of agricultural equipment and then subcontract same to local manufacturers for execution.
- **Agents of certification or control of agri-food products:** The agents of certification or control of agri-food products, such as DANA and LCSSA are involved in the subsector, according to two categories of actors: local manufacturers and policymakers. Their role is described as the implementation of government policy with regard to quality control of agri-food products. These agents also check whether the equipment manufactured meet the required standards for the processing of agri-food products.

Table 16. Actors involved in the manufacture of agricultural equipment according to categories of actors

Actors	Local manufacturers	Policy-makers	MGO-Experts	Raw materials providers	End-users
Manufacturers/Manufacturer's Association/Factories					
Large private equipment manufacturing companies (COBEMAG, etc.)					
End-users (producers, processors, breeders, etc.)					
NGO/PTF/Projets					
Intermediaries					
National policymakers (MAEP, MESTFP, etc.)					
Policymakers of local government agencies (ATDA, DDAEP, etc.)					
Tax collection agencies					
Microfinance Institutions (CL-CAM, PADME, BOA, etc.)					
Raw materials provider (hardware store, etc.)					
Scientists (INRAB, IITA, etc.)					
Trainers (schools, universities, etc.)					
Machine dealers or resellers					
Welders-Sheet metal workers-electricians-turners-iron-workers-mechanics					
Importers of machines and spare parts					
Students/learners					
Agents of certification or control of agri-food products (DANA, etc.)					
Subcontractors (formal private companies and firms)					

Table 17. Various collaborations carried out between the actors to determine the success of local manufacturers

Actors	Actors	Linkage information	Quotes
Agricultural Machinery Manufacturers/ Manufacturing Association/ Factories	MFIs	- credit loans and savings	The production of equipment requires raw materials and the associated costs are very high. Also, customers place orders at times when there is not enough capital available to do the job. Thus, given the low purchasing power of these manufacturers for the acquisition of raw materials, they maintain relations with MFIs for credit loans and savings.
	NGO-TFP-Project	Partnership /collaboration - link of help / support / assistance / donation/subsidy - Skills transfer/ capacity building link	Link of help /support / assistance / donation/subsidy to the manufacturers or their association through the projects by technical and financial support; advice-extension; business / money /exchange of goods and services: NGOs order and test agricultural equipment with manufacturers (the case of the FAO, Helvetas on storage structures) to help groups of processors and producers. Contracts are also awarded between NGOs/TFPs and manufacturers for the production of agricultural equipment that they want to offer to associations of producers, livestock breeders or processors; Skills transfer/capacity building link: because NGOs, TFPs and projects visit manufacturers' workshops or organize sessions with their group for refresher training or capacity building.
	National Policymakers (MAEP, SME-MICPE, MESRS, MESTFP, Ministry of the Interior)	- Training / Capacity building - Marketing /Business Money /exchange of goods and services	Help /support / assistance / donation / grant; Transfer of competence / capacity building / training; research / scientific study: MICPE and APRM provide technical and financial support to formal manufacturers through order contracts via calls for tenders. Policymakers organize sessions with manufacturers' associations for capacity building (visit; field school, follow-up, field demonstration). They assist these manufacturers in the dissemination of technologies. Business / Money /exchange of goods and services: Policymakers order agricultural equipment from manufacturers' associations for processors, producers and especially groups.

Actors	Actors	Linkage information	Quotes
	Local government body (ATDA DDAEP)	- Advisory / Extension - Partnership collaboration	(because ATDAs visit our workshops or organize sessions with our group to strengthen our capacities (visit; field school, follow-up, demonstration in a real environment, etc.). They assist us in the dissemination of technologies); Business /Money /Exchange goods and services: ATDAs order agricultural equipment from manufacturers' associations via calls for tenders, in order to exhibit and sell it to processors, producers, etc. ATDAs also direct processors (peanuts, cassava, etc.) or producers to the formal manufacturers competent to order the equipment.
	Raw Materials providers (Hardware store) from Nigeria (commonly known as Ibo), ghana or abroad	- Business/Money/ exchange of goods and services	Business /Money /Exchange of goods and services: These two (02) actors establish links of Business/Money/exchange of goods and services. Indeed, the materials (sheet metal, etc.) used by manufacturers in the production of agricultural equipment are purchased from these raw material supply companies
	Scientists from Research Organizations (INRAB, PTAA-INRAB, CRA-INRAB, University, IITA, ABREVIT)	- Research - Information - Business/Money/ exchange of goods and services	Research/scientific study; aid/support / assistance / donation/ grant; Transfer of competences/ capacity building /Business / Money /Exchange of goods and services through order contracts via call for tenders. Research collaborates with manufacturers for scientific studies and the collection of information to promote the development of agricultural mechanization. It also supports these manufacturers by providing them with technical support, etc. It also orders the manufacture of equipment for a fee.
	High School and University Students	- Training / Capacity building	Students receive hands-on capacity building training from agricultural equipment manufacturers. They also support local manufacturers in the manufacture of this equipment and the development of innovations, and inform them about changes and manufacturing methods.

Actors	Actors	Linkage information	Quotes
	Trainers or teachers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	- Training / Capacity building	"They are the ones who train us. The training centres order equipment from us to do practical sessions with the students. The trainers assist us in the development of technologies or the manufacture of machines (peanut processing, palm nuts) that they present to their students for demonstration sessions".
	Dealers or Agricultural Machinery Dealers/ Formal Private Companies or Firms	- Business/Money/ exchange of goods and services	Business/Money /exchange of goods and services: "they subcontract us when they find government and NGO markets "; Competition "because they can easily find call for tender markets compared to us".
	Tax collection agency	- Tax payment	Payment of tax duty; help / support / assistance / donation / subsidy "by facilitating the implementation of our company". Local manufacturers pay taxes to the Town council/tax office as part of their agricultural equipment manufacturing activities. As the town council is the first decentralized service of the State at the level of each commune, any activity on the territory of each commune requires the authorization of the town council.
	Mechanics/ Electricians/Turners/ Scrap metal dealers/Sheet metal workers	- Partnership / Collaboration - Business/Money/ exchange of goods and services	Link of Partnership / Collaboration /Assembling or combination of parts (engines, electrical, mechanical, etc.) to form/repair farm equipment. They intervene upstream in the chain for repair purposes. "We also collaborate with Mechanics/ Electricians/ Turners/Scrap metal dealers for the manufacturing of the necessary parts (motors, electrical parts, mechanical parts, etc.) in the manufacture of motorized equipment"; business link/ business/ money /exchange of goods and services: Indeed, during the collaboration, formal and informal contracts and exchanges of goods and services are carried out in return for remuneration.

Actors	Actors	Linkage information	Quotes
	End-users or customers (producers, processors, livestock breeders)	- Business/Money/ exchange of goods and services - Advisory	End-users (especially processing cooperatives) order the manufacture of equipment under informal or formal (mostly informal) contracts, with or without prepayment prior to production and delivery. Users buy agricultural equipment produced by local manufacturers. These manufacturers also give advice to users on how to use this equipment. Users help manufacturers improve the quality of manufactured equipment by identifying manufacturing defects.
	Formal/Informal Importers (private companies and Chinese)	- Business link - Partnership / Collaboration - Business/Money / Exchange of goods and services - Transfer of competence - Capacity building - Competition	Manufacturers buy imported machinery from importers to copy or pirate; the cost of equipment imported by these importers is lower than that of local manufacturers, which creates competition. Companies or importers request our services to assemble the imported equipment for payment.
	Direct sellers/ intermediaries (Private company)	- Business/Money/ exchange of goods and services	Business link / business/ money / exchange of goods and services: "direct sellers seek customers for manufacturers. Private companies order machines from us that they will exhibit and resell. These intermediaries or private companies (entrepreneurs) win the Government markets linked to the supply of a given agricultural equipment, and not having the capacity to produce, then entrust us with the realization of this equipment in return for a fee. They earn more than we do."

Actors	Actors	Linkage information	Quotes
	National policymakers (MAEP, SME-MICPE, MESRS, MESTFP, Ministry of the Interior)	- Partnership / Collaboration	Partnership /Collaboration: because they maintain collaborations with certain MFIs to facilitate access to credit for producers' associations.
	Importers	- credit loan	credit loan linkage because importers apply for loans from MFIs in order to have sufficient capital to facilitate agricultural equipment import activities.
	Tax collection agencies	- payment of tax	MFIs pay taxes to the town council and the tax department. Policymakers collaborate with MFIs to facilitate loans to farmers', processors', manufacturers' associations.
	NGO/FTP/Project	- Partnership / Collaboration	Link of Partnership / Collaboration/ Assembling: as NGOs collaborate with MFIs to facilitate loans to manufacturers, producers, etc.
	Farm Machinery Dealers or Traders	- Credit loan	Payment of tax duties; loan link: Informal machine traders apply for loans from MFIs for the purchase and sale of agricultural equipment.
	Mechanics/ Electricians/Turners/ Scrap metal workers /Sheet metal workers/Welders	- Credit loan - Control	Linking loans and monitoring or controlling the progress of the lender's (manufacturer's) activities by MFIs to see if the sub-loaned funds are actually being used for the activity to which the loan was made.
	Sellers of spare parts or raw materials (Hardware store)	- Credit loan	
	Raw material suppliers	- Credit loan	Users (producers, processors) apply for loans from MFIs to purchase agricultural equipment.

Actors	Actors	Linkage information	Quotes
	Local government body (ATDA, DDAEP)	- Partnership/ Collaboration / Assembling link	Because ATDAs collaborate with MFIs to facilitate loans to associations of farmers, processors, and manufacturers. Partnership/Collaboration /Assembling link
	Trainers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	- agricultural credit	The loan application is made by some of the private centres because they need capital to run their business.
Members of NGOs /TFPs (Songhai Project, Helvetas, GIZ) Intergovernmental organization (FAO), projects (PAIA-VO, PASDER, PROCAR, PADAC, UNDP, TAZCO)	Policymakers	- Payment of fees - Partnership/ Collaboration/ Assembly	Local government body (Town council, Tax Department): Payment of fees; Partnership/Collaboration/ Assembly / The town council is the first authority that must be consulted before joining the commune. Project managers are in partnership with the town council for the execution of the projects since the town council is the first decentralized service of the State at the level of each commune, any activity on the territory of each commune requires the authorization of the town council. The town council is also financed by these projects for certain activities.
	End-users (farmers/ producers, processors)	Business/Money / Exchange of goods and services help/support/coaching/ donation/grant; Skills transfer/capacity building/training	Groups of processors and producers win NGO/PTF markets via calls for tenders; The NGOs/Projects assist users (producers, processors) in agricultural activities by providing them with training, extension advice and other support (technical, financial, etc.).

Actors	Actors	Linkage information	Quotes
	Scientists from Research Organizations (INRAB, PTAA-INRAB, CRA-INRAB, University, IITA, ABBREVIATED)	- help/support/assistance/donation/grant; Partnership/Collaboration/Assembling	The NGOs/Projects are in partnership with research for the development of the agricultural equipment manufacturing sector.
	High school and university students	- Skills transfer/capacity building	For internship purposes
	Formal private companies or firms	- Business/Money/Exchange of goods and services - Partnership/Collaboration/Assembly	Formal private companies find contracts for the supply of equipment through calls for tenders. NGOs/Projects are in partnership with private companies for activities requiring agricultural equipment. These NGOs/Projects also provide training to these companies. These two (02) actors are also in business relationship when these private companies win markets at the level of these NGOs for the manufacture of agricultural equipment
	Mechanics/Electricians/Turners/Scrap metal workers /Sheet metal workers	- Business /Money /exchange of goods and services - help /support / assistance / donation/grant	Mechanics/Electricians/Turners/Scrap metal workers /Sheet metal workers find equipment supply contracts through NGO call for tenders, when they are in good standing. NGOs/Projects offer capacity building trainings to mechanics, turners, etc..
	Raw materials providers	- Business/Money/Exchange of goods and services	The members of NGOs/TFPs (Songhai Project, Helvetas, GIZ are also involved in the project: NGOs also support raw material suppliers in their activities. NGOs can also do business with these suppliers by going to their places to get raw materials to manufacture equipment.

Actors	Actors	Linkage information	Quotes
	Trainers or teachers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	- Partnership/ Collaboration/ Assembling - Business/Money / Exchange of goods and services	Partnership for project implementation
Scientists from Research Organizations (INRAB, PTAA-INRAB, CRA-INRAB, University, IITA, ABREVIT)	Importers of agricultural machinery (private companies and Chinese)	- Research	
	Members of NGOs/TFPs (Songhai Project, Helvetas, GIZ) Intergovernmental Organization (FAO), Projects (PAIA-VO, PASDER, PROCAR, PADAC, UNDP, TAZCO)	- Partnership/ Collaboration/ Assembly; - help / support / assistance / donation / grant	The NGOs/Projects are in partnership with research for the development of the agricultural equipment manufacturing sector.
	High school and university students	- Training	Students receive training in the research institutions where they go for internships.
	Trainers or teachers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	- Business/Business/ Money/Exchange of goods and services - Partnership/ Collaboration/ Assembly	Partnership for project implementation

Actors	Actors	Linkage information	Quotes
	Formal/informal importers: Business/ Business/Money/ Exchange of goods and services	- Partnership/ Collaboration/Assembly	The importers maintain business partnerships with the Government to import machines through call for tenders. Partnership/Collaboration/Assembly
	End-users (producers, processors, livestock breeders)	- research/scientific study; - Skills transfer/ capacity building/ training; - Business/money/ exchange of goods and services; - aid/support/ assistance / donation/grant	
	Mechanics/ Electricians/Turners/ Scrap metal workers/Sheet metal workers	- research/scientific study; - Skills transfer/ capacity building/ training.	

Actors	Actors	Linkage information	Quotes
Policymakers: National government agency (MAEP; MICPE)	Policymakers: National government agency (Ministry of Higher Education and Scientific Research: MESRS; Ministry of Secondary, Technical and Vocational Education and Training: MESTFP)	- Partnership/ Collaboration/ Assembling	
	Certification or control agency of agricultural products	- command or order link; - help / support / assistance / donation / grant	
Policymakers: National government body (MAEP, PME-MICPE, MESRS, MESTFP, Ministry of the Interior)	Scientists from Research Organizations (INRAB, PTAA-INRAB, CRA-INRAB, University, IITA, ABREVIT)	- Partnership/ Collaboration/ Assembly - Order command link - help /support / assistance / donation/grant	Research takes orders from Policymakers in the context of agricultural mechanization activities; The research works in partnership with the MAEP, which provides financial support for the certification of locally manufactured or imported machinery. They are there like state scouts in subsidizing local manufacturers. Partnerships are developed with university teachers in project implementation.
	Tax collection agency	- Partnership/ Collaboration/ Assembling relationship	To assist manufacturers, command or order: national government agencies also give orders to local government agencies.

Actors	Actors	Linkage information	Quotes
	Members of NGOs/PTFs (Songhai Project, Helvetas, GIZ) Intergovernmental organization (FAO), projects (PAIA-VO, PASDER, PROCAR, PADAC, UNDP, TAZCO)	- Partnership/ Collaboration/ Assembly - help/support / assistance / donation/grant - command or order:	"The Ministries are aware of what NGOs in the field are doing to capitalize on its actions. The Ministries assist NGOs, producers, processors and manufacturers through the following projects. In addition, Policymakers control the activities of these NGOs/ Projects on the national territory."
	Trainers or teachers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	- Order link. - help /support / assistance / donation/grant of training centres.	The Policymakers support the training centres by donating equipment. Partnerships are developed with university teachers in project implementation.
	End-users (producers, processors, livestock farmers)	- aid/support/ assistance/grant link - Skills transfer/ capacity building/ training of manufacturers, farmers, processors, women's associations	Policymakers support users (groups of producers and processors) by providing them with the necessary technical (agricultural equipment, etc.) and financial support, training and advisory extension services in the agricultural sector.
	Formal/informal importers	- Partnership/ Collaboration/ Assembling - Business / Business/ Money /Exchange of goods and services	The case of the Chinese with ATDA, also the State is involved in all the activities of foreigners (Chinese, Japanese); Importers maintain business links with the Government (Ministry of the Interior, MICPE, MAEP) to import machinery. Also, Policymakers assist importers in their activities. These companies find markets for subsidies or the local manufacture and import of equipment, via calls for tenders.

Actors	Actors	Linkage information	Quotes
Policy makers: National government body (MAEP; MICPE, MESRS, MESTFP)	High school and university students:	- help /support / assistance donation / subsidy	for internship purposes, assistance to students in their entrepreneurship project
Policy makers: National government agency (APRM; MICPE)	Raw materials providers	- Business / Business / Money /Exchange of goods and services	Business / Business /Money /Exchange of goods and services through procurement organized by government agencies.
Local government body (ATDA, DDAEP)	NGO/PTF members (Songhai Project, Helvetas, GIZ) Intergovernmental organization (FAO), projects (PAIA-VO, PASDER, PROCAR, PADAC, UNDP, TAZCO):	- Partnership/ Collaboration/ Assembling; - help /support / assistance / donation/grant to assist manufacturers, farmers, processors and women's associations.	Policy makers and members of NGOs work together to implement projects related to mechanization and to provide financial and technical support to manufacturers.
	High school and university students	- Skills transfer/ capacity building/ training	Skills transfer /capacity building /training to students through internships.
	Traders/resellers of agricultural equipment	- Business/ business/ money /exchange of goods and services.	

Actors	Actors	Linkage information	Quotes
	End-users or clients (producers, processors, livestock breeders)	- advice-extension, Business/business/ Money/exchange of goods and services - Skills transfer/ capacity building / training /assistance/ support/guidance/ donation/subsidy	ATDAs provide technical and financial support to producers, processors, breeders and groups with regard to monitoring, extension, training and subsidies. These users also purchase machines from ATDAs.
	Polymakers: National government body (MAEP, PME-MICPE, MESRS, MESTFP, Ministry of the Interior)	- command or order link; - help /support / assistance / donation/grant.	
	Tax collection agency	- Partnership/ Collaboration/ Assembling	relationship for the development of agricultural mechanization.
	Tax collection agency	- Partnership/ Collaboration/ Assembling - Business / Business/ Money /Exchange of goods and services	ATDAs collaborate with importers to import machines; Importers maintain business partnerships through contracts with Polymakers to import machinery for the benefit of producers and processors.
	Trainers or teachers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	- Partnership/ Collaboration/ Assembling	The ATDAs are in partnership with the trainers for the development of agricultural mechanization.

Actors	Actors	Linkage information	Quotes
	Researchers from Research Organizations (INRAB, PTAA-INRAB, CRA-INRAB, University, IITA, ABREVIT)	Partnership/ Collaboration/ Assembling link for the development of agricultural mechanization.	
Tax collection agency	Raw material suppliers	Payment of tax duty	Suppliers of raw materials pay taxes to the town council as part of their material supply businesses.
	End-users (producers, processors, farmers, traders)	- Payment of tax duty - Partnership/ Collaboration linkage	Users pay taxes to the town council as part of their businesses. As the town council is the first decentralized service of the State at the level of each commune, any activity on the territory of each commune requires the authorization of the town council. These two actors are also in partnership for some projects.
	Members of NGOs/TFPs (Songhai Project, Helvetas, GIZ) Intergovernmental organization (FAO), projects (PAIA-VO, PASDER, PROCAR, PADAC, UNDP, TAZCO)	Payment of tax duty	NGOs/Projects pay taxes to the town council as part of their activities.
Intermediaries(private enterprise)	Local government body (ATDA, DDAEP):	Business / Business/ Money /Exchange goods and services.	These private companies find markets with Policymakers when they are in good standing.

Actors	Actors	Linkage information	Quotes
	Mechanics/ Electricians/ Turners/ Scrap metal workers/ Sheet metal workers / Welders	- Business/Money / Exchange of goods and services.	Mechanics/ Electricians/Turners/ Scrap metal workers / Sheet Metal Workers/Welders obtain contracts from intermediaries or companies when they are in good standing.
	Tax collection agency	- Business/Money / Exchange of goods and services	These private companies find markets with Policymakers when they are in good standing.
	Members of NGOs/ TFPs (Songhai Project, Helvetas, GIZ, Helvetas) Intergovernmental organization (FAO), projects (PAIA-VO):	- Business/Money/ exchange of goods and services	These private companies find contracts with NGOs/TFPs when they are in good standing.
Trainers or teachers from public and private centres (Songhai Project, CPU-EPAC, University, High School)	Students from High Schools and Universities:	- Skills transfer / capacity building/ training.	"Indeed, the trainers provide the students with the necessary knowledge through a well elaborated theoretical and practical training on the manufacture and maintenance of agricultural equipment."
	Mechanics/ Electricians/ Turners/ Sheet metal workers/ Welders	- Skills transfer/ capacity building/ training	As trainers provide training to mechanics, electricians, turners, sheet metal workers and welders for the job market.
	Tax collection agency	- Payment of tax duty	Trainers pay taxes and duties as part of their training businesses.

Actors	Actors	Linkage information	Quotes
	End-users (producers, processors, livestock breeders, traders):	- Skills transfer/ capacity building/ training:	The trainers offer training to end-users for the job market, for the development of technologies through workshops, training courses, etc.
High School and University Students	Mechanics/ Electricians/Turners	- Skills transfer/ capacity building/ training	Students go to mechanics, electricians, turners for internships.
	MFI	- Credit loan	"When they complete their training and want to settle down, they approach MFIs to take out loans for capital needs."
	Importers of agricultural machinery (private companies and Chinese)	- Skills transfer/ capacity building/ training	As students receive hands-on training in these private companies where they go for internships.
	End-users (producers, processors, livestock breeders, traders)	- Skills transfer/ capacity building/ training	as students go to these end-users' companies for practical internships, and research/scientific studies.
Body for certification or control of agri-food products (DANA)	Local government body (ATDA, DDAEP)	- command or order	ATDAs receive orders from control bodies.
	End-users or clients (producers, processors, livestock breeders)	- Verification/ Inspection of finished products	The certification bodies control the quality of agri-food products manufactured by processors. They also control the equipment that will be used for the processing of these agri-food products.

Actors	Actors	Linkage information	Quotes
Mechanics / Electricians / Electricians/Turners /Scrap metal workers /Sheet metal workers and Welders	Raw Material Suppliers	- Business/Money / Exchange of goods and services	Mechanics, turners, etc. do business with raw material suppliers. Indeed, these mechanics, turners, etc. buy spare parts from suppliers for the repair of agricultural equipment.
	private companies	- Business/Money / Exchange of goods and services	These two actors are in a business relationship in the manufacture of agricultural equipment. Indeed, private companies request the services of mechanics and turners for tasks specific to their fields in the manufacturing process of this equipment.
	End-users (producers, processors, livestock breeders, traders)	- Business/Money / Exchange of goods and services	For the payment of repair costs in the event of a breakdown. The mechanics, turners take care of the repair of the users' equipment when they are out of order
	Hardware store (Sellers of spare parts or raw materials from Nigeria (commonly known as ibo), Ghana, or outside)	- Business/Money / Exchange of goods and services	For the purchase of raw materials or spare parts. Mechanics, electricians, etc. buy spare parts in these hardware stores to repair broken down farm equipment.
	Tax collection agencies	- Payment of tax duty - skills transfer/ capacity building/ training link	Mechanics, turners, etc. pay taxes to the town council as part of their activities." Policymakers assist mechanics, turners, etc. in their activities through training in business management, maintenance of agricultural equipment and other support.

Actors	Actors	Linkage information	Quotes
Resellers or Dealers of agricultural machinery or spare parts or raw material (Hardware store) from Nigeria (commonly known as ibo), Ghana, or outside	End-users or customers (producers, processors, livestock farmers)	- Business/Money/ Exchange of goods and services	Machinery dealers buy agricultural equipment from manufacturers and resell it to end-users. These two (02) players are therefore in a business relationship.
	Direct sellers/ Intermediaries	- Business /Money / Exchange of goods and services	Direct sellers/intermediaries seek customers for traders.
	Raw material providers	- Business/Money / Exchange of goods and services	Resellers or machine dealers buy spare parts from raw material suppliers and resell them. These two players therefore establish a business relationship
	Tax collection agencies PolicyMakers	- Payment of tax	Resellers or dealers of agricultural machinery pay taxes to the town council and the tax department
Importers of agricultural machinery (private companies and Chinese)	End-users or customers (producers, processors, livestock breeders)	- business link / business/Money / exchange of goods and services	For the purchase of machinery. Users buy agricultural equipment from importers for their activities.
	Raw materials providers	- Business/Money / Exchange of goods and services	Raw material suppliers do business with importers. They buy spare parts from these importers that they resell to agricultural equipment manufacturers. These suppliers will therefore replenish their supplies or order parts from these importers.
	Mechanics / Electricians/Turners / Scrap metal workers / Sheet metal workers / Welders/ Painters	- Business link/ Business/Money/ Exchange of goods and services	Mechanics/electricians/turners/scrap metal workers /sheet metal workers/welders/painters will sometimes go to private importers to get supplies or to order parts (engines, work tools). These private companies also request services from mechanics and turners for assemblies and repairs of imported machinery

Actors	Actors	Linkage information	Quotes
	importers of agricultural machinery	- Business/ Money/ exchange of goods and services - Competition	Private companies' partner with importers to adapt imported machinery to local conditions so that it meets the needs of users: These two (02) actors are also in business relationship for the purchase of spare parts and agricultural equipment. They are also in competition because imported machines compete with locally manufactured machines.
	Tax collection agencies	- Payment of tax duty	Importers pay taxes to the town council in the framework of their import business of spare parts and agricultural equipment.
End-users (producers, processors, livestock breeders)	Raw materials providers	- Business/Money / Exchange of goods and services	Users obtain spare parts for their equipment from raw material suppliers when these are faulty
	Large Private machine manufacturing companies (COBEMAG)	- Business/Money / Exchange of goods and services	These two actors are in business because the users buy the agricultural equipment produced in these large private companies.
	Intermediaries / direct sellers	- Business/Money / Exchange of goods and services	Direct sellers are used as intermediaries sometimes for the purchase of spare parts or machines. Intermediaries find manufacturers to producers, processors, breeders in case of need, against payment (10%). They help processors and producers to export their products.

Average levels of stakeholder influence in determining the success of local manufacturers

The distribution of the average current level of influence of the actors in the agricultural machinery manufacturing chain in Benin, according to their categories, is presented in Table 18. Note that the range of the level of influence was from 0 to 10. The data show that end-users (producers, breeders, processors, and their associations) had a level of influence of 9.69; followed by small manufacturers and their associations (8.53), and large private equipment manufacturing companies (8.50). The observed differences show that large private equipment manufacturing companies, end-users, and small manufacturers and their associations; and suppliers of raw materials were perceived to be the most influential players. The same applies to formal private companies and firms (subcontractors), policymakers in national government organization (MESRS , MESTFP) who invest in training, and agricultural equipment dealers or traders (8.0). The high score given to large and small private equipment manufacturers (8.50) by manufacturers is explained by the fact that they are at the heart of the local equipment manufacturing chain. The response of one of the respondents was:

We are the basis of local equipment development. Without us, producers and processors cannot develop. Without them, there is no agricultural equipment.

The very high level of influence attributed to end-users (9.7) is explained by the fact that the equipment produced are reserved for producers, processors and livestock breeders. Without them, manufacturers have no reason to be. According to one of the respondents:

It is mainly producers and processors who come to us. Without them, we cannot produce and sell. Despite the size of our company, they trust us.

More so, stores of raw materials received high score because they were the source of supply for manufacturers and end-users. In the quality data, a respondent said:

Without them, you cannot have the raw materials to produce. They are the ones who supply the parts used in the manufacture of agricultural equipment. But there are others who are in the informal sector who import fake parts.

Subcontractors (formal private companies and firms) were also assigned high level of influence (8.0) because they help identify work and market opportunities for manufacturers. One of the interviewed respondents had stated:

Although it is true that they subcontract to us and get enough profit than us on markets, they entrust us with these markets. This allows us to have an income.

Policymakers in national government organizations that invest in training also scored high because

they were involved in training or capacity building of prospective manufacturers in agricultural colleges and universities. According to the qualitative data:

Policymakers also have great influence through investment in the training of students. These trainings equip prospective manufacturers with the necessary skills.

Machine resellers or dealers had high level of influence because they represent the actors who contribute to the marketing of the local equipment produced. A respondent had said that ***‘they allow manufacturers to sell their equipment and have access to parts.’***

Furthermore, with regard to policymakers (of national organizations), end-users (with level of influence of 9.0) and NGOs/TFPs/projects had higher scores. They believed that end-users were very influential in the chain, being those for whom manufacturers produce equipment. Without them, therefore, equipment manufacturers have no reason to be.

A high score was given to NGO/PTF/projects (8.5) because their level of intervention or assistance was considerable, contributing greatly to the development of agricultural mechanization. They helped provide access to the marketing of local products through their collaboration with companies, intermediaries, direct sellers, etc. A respondent stated that:

They find markets for manufacturers and assist them. They have a great influence in the field because through their activities, they support the different actors (producers, processors, etc.). This contributes greatly to the development of agricultural mechanization.

End-users, welders-sheet metal workers-electricians-turners-scrap metal workers, NGOs/TFPs/projects and scientists were perceived by NGO experts as actors with the highest influence (10.0). This high score is explained by the fact that end-users helped manufacturers improve the quality of manufactured equipment by pointing any observed defect. Sheet metal workers-electricians-turners-scrap metal workers-mechanics had a great deal of influence (9.0) because they worked closely with manufacturers in the production of equipment. The NGOs/TFPs/projects also had high level of influence (8.0) because their various forms of support (equipment support for agricultural cooperatives) contributed greatly to the development of agricultural mechanization. Scientists from research organizations (INRAB , PTAA-INRAB , CRA-INRAB , university, IITA , ABREVIT) were also given high level of influence (8.0), since they assisted manufacturers through training, development of innovations, and extension, as well as in purchasing agricultural equipment.

Raw materials providers affirmed that manufacturers/associations of manufacturers, end-users, national and local government policymakers, and microfinance institutions were actors that mainly influenced the activities of local manufacturers. The high score attributed to manufacturers/associations (10.0) was explained by the fact that they contributed locally to the development of mechanization, thereby adding value to local products. Also, the high score attributed to end-

users was explained by the fact that they stimulated the demand for agricultural equipment. Accordingly, a respondent stated that:

End-users have a great influence because it is for them that manufacturers produce the equipment. The higher the demand, the more work for manufacturers and other players; hence, everyone wins.

National policymakers were also given high level of influence based on their role as makers of policy in support of agricultural mechanisation. MFIs also had high influence, since they financially supported the actors involved in equipment manufacturing through loans. Town council/tax department had high level of influence (9.0), as they acted as facilitators of projects and NGOs working in the field.

Furthermore, compared to the statements on the end-user category, Table 18 shows that manufacturers and their associations (with influence level of 10.0), end-users (10.0) and intermediaries or direct sellers (8.5) were the most influential actors. The influence of intermediaries or direct sellers was high because they represented the market corridors for equipment manufacturers and also promoted access to spare parts. A respondent explained that:

They are the ones who look for the market and help us to sell our products. They tend to win big markets from policymakers and exploit us. As a result, they make more profit than we do.

Importers of machinery and spare parts, agri-food product certification or control agents, local government policymakers (town council/ tax department), local government policymakers (ATDA , DDAEP , etc.), national government policymakers (MAEP , MICPE , etc.) had the lowest level of influence. This trend was mostly evident in the data from the manufacturer respondents. Importers of machines and spare parts had less influence (4.86) in local manufacturing because they competed with local manufacturers; they destroyed efforts made by manufacturers and the market by importing equipment that did not meet local needs. According to the qualitative data:

They have a bad influence in the chain because imported machines compete with locally manufactured machines. They import machines that do not meet the needs of the users.

Local government policymakers (and national government policymakers) had little influence in the field (5.66) because of their low level of intervention or support especially towards small-scale manufacturers. This was evident in the responses received during the interviews:

They have very little influence because they do not sufficiently encourage the development of innovations in the field of agricultural equipment manufacturing. They entrust markets mainly to large manufacturers. They import machines that are not of quality and do not meet the needs of

users. They do not have much influence because their programmes on agricultural equipment do not work well. They lack organization.

Agents of certification or control of agri-food products (DANA , etc.) had low level of influence (5.0) because they did not intervene in the control of local equipment at the production stage, but rather in the control of already purchased products by end-users. Local government policymakers (town council/ tax department) had low level of influence (5.07) due to their taxation pattern, and their unannounced visits.

The tax department has the right to levy taxes on manufacturers’ activities, but sometimes they come unannounced to impose sudden taxes. During periods of financial hardship, these taxes may be too high. They cause the closure of workshops for the manufactures of agricultural equipment. They thus have little influence because they lack initiative in the field of agricultural equipment.

Table 18. Average levels of influence of the actors

Stakeholder categories	Local manu- facturers	Policy- makers	MGO- Experts	Raw materials providers	End- users	All actors	Test
End-users (produc- ers, processors, etc.)	9.7	9	10	10	10	9.69	0.36
Manufacturers/ Manufacturers As- sociation	8.35	8	7	10	10	8.53	0.86
Large private equipment manufacturing companies (COBEMAG, etc.)	10		7			8.5	
Subcontractors (formal private companies and firms)	8					8	
Sheet metal workers, welders- electricians- turners-scrap metal workers-mechanics	7.5	7	9	8	9	7.8	0.60
NGO/PTF/Projects	7.6	8.5	8	8	7.5	7.75	0.09
Suppliers of raw materials (hardware, etc.)	8.16	8	3	8	7.5	7.68	1.68

Stakeholder categories	Local manu- facturers	Policy- makers	MGO- Experts	Raw materials providers	End- users	All actors	Test
Resellers or ma- chine dealers	8	8	7	5		7.56	6.85 **
Researchers (INRAB, IITA, etc.)	7.42	8	8		5	7.36	0.40
Intermediaries	7.25	8		5	8.5	7.33	0.48
Microfinance in- stitutions (CLCAM, PADME, etc.)	6	7	4	10	7	6.37	1.07
Trainers or teach- ers (high schools, universities, etc.)	6.8	7	5	7	5	6.5	0.47
Polycymakers (ATDA, DDAEP, etc.)	5.57	4		8		5.66	0.90
National Polycymak- ers (APRM, MICPE; MESTFP, etc.)	5.33	7	4	10	4.5	5.66	1.02
Students/learners	5.8	6	5	6	5	5.64	0.06
Polycymakers (Town Council / Tax De- partment)	4.8	3	4	9	6	5.07	1.09
Agents of certifi- cation or control of agri-food products (DANA, etc.)	4.5	6				5	3.00
Importers of ma- chines and spare parts	4.25	6		4	7	4.86	0.64

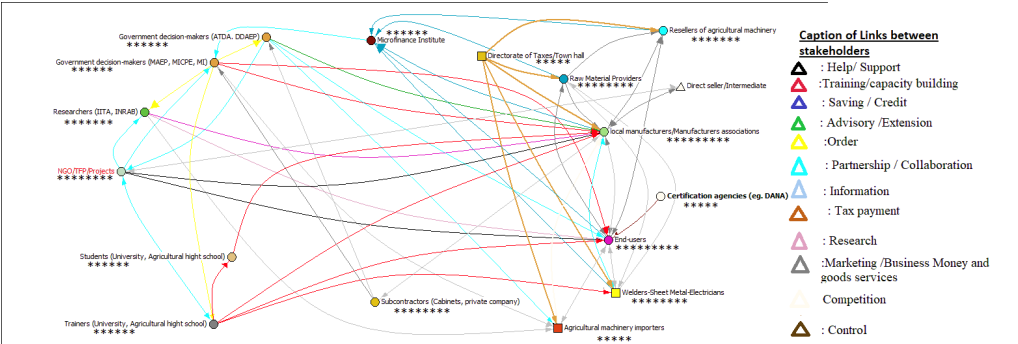


Figure 1. Illustration of the aggregated Netmap

Bottlenecks in the links between actors and actions

In the various collaborations between the different actors in the local manufacturing of agricultural equipment, certain bottlenecks weakened the relationship (Table 19). The main bottlenecks listed by the actors interviewed were:

- Difficulty in access to credit for actors (manufacturers, end-users, sheet metal workers, electricians, turners, scrap metal workers, and mechanics) in MFIs. Manufacturers and end-users said that there were too many requirements for loan guarantee, and interest rates were high. Also, MFIs did not generally grant the amount requested; sometimes, they delayed the process due to certain administrative bottlenecks.
- Non-compliance with the terms of production and sales contracts: During collaborations, some actors did not respect the terms of contract (delivery time, payment terms, etc.) which are, in most cases, verbal, thus creating a climate of lack of trust between these different actors;
- Corruption and misappropriation of funds in collaboration between policymakers and NGOs: These scourges that have existed for ages have encouraged a climate of lack of trust between these actors;
- Difficulty in the repayment of loans received from MFIs due to market access problems. The difficulty in finding markets for the manufactured equipment often affected repayment of loans from MFIs by local manufacturers;
- Weak technical and financial support to manufacturers, mechanics, etc. from policymakers and NGOs/TFPs. Governments and NGOs did not sufficiently support the local agricultural equipment manufacturing subsector

For the equipment manufacturers interviewed, the bottlenecks at the level of linkages between actors, and the actions proposed for overcoming each of these are presented in order of priority in Table 19 (deduced from the statistics in Table 24).

Table 19: Identified bottlenecks and actions proposed for overcoming them (by manufacturers)

Local manufacturers		
Rank	Bottlenecks	Proposed actions
1	Non-compliance with the terms of production and sales contracts during collaborations between manufacturers, customers, suppliers of raw materials, direct sellers, merchants, etc.;	Establishment of formal written contracts during the different collaborations and respect of these contracts under penalty of heavy sanctions as well as a personal willingness of each actor involved in these collaborations to respect the contracts in order to re-establish a climate of trust;

Local manufacturers		
Rank	Bottlenecks	Proposed actions
2	Difficulty in accessing credit from MFIs for the manufacture of agricultural equipment;	Facilitating access to credit by reducing interest rates, easing the conditions for granting it and the guarantees required. The Government and NGOs should also support MFIs through subsidies to facilitate access to credit for manufacturers and other direct actors in the manufacturing chain. The Government should also fight against discrimination in the granting of credit by making strict controls at the level of these institutions;
3	Difficulty related to the repayment of loans received from MFIs due to market access problems;	Promote market access by awarding public procurement contracts to manufacturers, organizing workshops and trade shows to add value to local equipment so that manufacturers can have the necessary resources to repay loans taken out with MFIs;
4	Corruption and embezzlement at the level of collaboration between Policymakers (MAEP, ATDA, etc.) and NGOs;	Vote for laws with heavy penalties for non-compliance to reduce the problems of corruption and embezzlement in government services. The Government should also set up an external monitoring and control team at the level of each service in order to reduce these scourges;
5	Weak technical and financial support for manufacturers, mechanics, etc. from Policymakers and NGOs/TFPs;	Regular technical and financial support to national and Policymakers, projects and NGOs for the development of efficient local machines. This support also includes advice and extension, training and capacity building for the various actors in the manufacturing chain. The Government should also develop a policy of subsidies to local artisans;
6	Surcharge of tax duties and fees by the agents of the town council and the tax department;	Reduction of tax duties and fees by Policymakers to enable agricultural equipment manufacturing activities to develop;
7	Unannounced and disruptive visit of tax and duty collection officers.	Definition of visit programme for tax and duty collection agents.

For the policymakers interviewed, the bottlenecks at the level of links between actors, and the measures proposed for overcoming each of them are presented in order of priority in Table 20, based on the statistics in Table 24.

Table 20: Identified bottlenecks and measures for overcoming them (by policymakers)

Policymakers		
Rank	Bottlenecks	Proposed actions
1	Non-compliance with the terms of production and sales contracts during collaborations between manufacturers, customers, suppliers of raw materials, direct sellers, merchants, etc.;	Drafting of formal contracts during the various collaborations between the actors and involvement of law enforcement agencies to enforce the terms of the signed contracts;
2	Difficulty in accessing credit from MFIs for the manufacture of agricultural equipment;	State support to facilitate access to credit at a low interest rate and with lighter loan conditions. Also strengthen the partnership between Policymakers and MFIs for more efficient loan granting services;
3	Corruption and embezzlement at the level of collaboration between Policymakers (APRM, ATDA, etc.) and NGOs.	Taking the necessary measures to reduce misappropriation of funds. For example, the implementers of the various projects in the sector should pre-finance these projects and be paid at the end of the implementation of these projects so that donors can verify the results before reimbursing them.

For the NGO/TFP/project experts, the bottlenecks at the level of linkages between actors, and the measures proposed for overcoming each of these are presented in order of priority in Table 21, based on the statistics in Table 24.

Table 21. Identified bottlenecks and measures proposed by NGOs/PTFs/ projects for overcoming them

NGOs/PTFs/projects		
Rank	Bottlenecks	Proposed actions
1	Difficulty in accessing credit from MFIs for the manufacture of agricultural equipment;	Facilitation of access to credit for manufacturers by Policymakers and NGOs;
2	Difficulty related to the repayment of loans received from MFIs due to market access problems ;	Facilitation of market access through the organization of equipment trade shows during which all local manufacturers will be brought together. These shows will allow them to make themselves known and to sell their products in order to be able to repay their loans;

NGOs/PTFs/projects		
Rank	Bottlenecks	Proposed actions
3	Lack of competences of certain actors such as manufacturers, mechanics, electricians, etc. The actors directly involved in the manufacture of agricultural equipment do not have sufficient skills in this activity. This is reflected in the quality of the equipment manufactured;	Categorization and registration of all manufacturers (formal and informal) for follow-up and training or capacity building. The Government should also create a body to control the equipment produced in order to reduce poor quality equipment on the market;
4	Insufficient practical sessions in training centres. These actors judged the training received by the students or learners in the training centres to be too theoretical. This results in low skill levels among students who settle after graduation to work in the trade;	Increase in practical sessions in training centres. These actors affirmed that theory should be associated with practice in the different training centres, i.e. as many theoretical sessions as practical sessions, or even more, should be set up;
5	Importation of machines that do not meet the needs of users by ATDAs, NGOs, importers. Indeed, users of these imported machines often complain that these machines are not adapted to local conditions and therefore quickly break down or are no longer used after a while;	Encourage local production through technical and financial support from Policymakers to local manufacturers. These local manufacturers should also carry out a study of customer needs before manufacturing the equipment;
6	Difficulty for Policymakers to control the activities of informal manufacturers. Indeed, more and more people are involved in the manufacture of local equipment even without having the expertise and especially without being formally registered. This makes it difficult for Policymakers at various levels to control this sector	Census and categorization of all manufacturers (formal and informal) for regular monitoring and control. The Government should also create a body to control the equipment produced by these local manufacturers.

For the raw material suppliers, the bottlenecks in the links between actors and the actions for overcoming them are presented in order of priority in Table 22, deduced from the data in Table 24.

Table 22: Bottlenecks and measures for overcoming them (by raw material suppliers)

Raw material suppliers		
Rank	Bottlenecks	Proposed actions
1	Difficulty related to the repayment of loans received from MFIs due to market access problems;	MFIs increase loan repayment delays. Indeed, these actors, apart from the problems of access to the market, consider the deadlines for repayment of the credits given by these institutions to be too short;
2	Non-compliance with the terms of production and sales contracts during collaborations between manufacturers, customers, suppliers of raw materials, direct sellers, merchants, etc.;	Establishment of formal written contracts during the different collaborations and respect of these contracts under penalty of heavy sanctions as well as a personal willingness of each actor involved in these collaborations to respect the contracts in order to re-establish a climate of trust;
3	Difficulty in accessing credit from MFIs for the purchase of raw materials (spare parts, etc.);	Facilitation of access to credit for all players in the equipment manufacturing chain by easing loan conditions and reducing interest rates;
4	Corruption and embezzlement at the level of collaboration between Policymakers and NGOs;	Fight against corruption and misappropriation of funds within these structures;
5	Manufacture of equipment of low quality and not fully meeting the needs of users. These actors stated that users often complain about the poor quality of equipment purchased from local manufacturers because the equipment often breaks down. These buyers then come to buy spare parts from them to repair the equipment;	Providing local manufacturers with good trainers to strengthen their skills in manufacturing agricultural equipment;
6	Difficulty of access to quality raw materials (spare parts). These actors explained that access to quality raw materials is very difficult because of the high costs and the lack of control at the borders of goods entering the national territory;	Strict control by the Government of the quality of raw materials (spare parts, etc.) entering the national territory;
7	Difficulty in paying taxes and fees due to market access problems. Difficulties related to market access are a real hindrance for local manufacturers because, for lack of means, they are unable to fulfil their civic duty;	Reduction of tax duties and fees for players in the equipment manufacturing chain. For these players, apart from the difficulties related to market access, tax duties and fees are high and do not correspond to the activities carried out by these players. The Government should therefore review these fees;

Raw material suppliers		
Rank	Bottlenecks	Proposed actions
8	Competition between importers and local machine manufacturers. Buyers often turn to imported machines because they are generally of better quality than locally manufactured machines, which is a disadvantage for local machines.	Promotion and valorisation by the Government of locally manufactured equipment and financial support to local manufacturers.

For the end-users, the bottlenecks at the level of linkages between actors and the actions proposed for overcoming them are presented in order of priority in Table 23, based on the data in Table 24.

Table 23: Bottlenecks and measures for overcoming them (by end-users)

End-users		
Rank	Bottlenecks	Proposed actions
1	Corruption and embezzlement at the level of collaboration between Policymakers and NGOs;	Definition of preventive measuresby Policymakers and reframing of the role of each structure in order to recreate the links between these structures;
2	Manufacture of equipment of low quality and not fully meeting the needs of users. These users complain about the poor quality of some locally manufactured equipment and the repetitive breakdowns they face. They also consider this equipment to be slow, too heavy and therefore difficult to move.	Capacity building of local manufacturers through training sessions, advisory and extension services to be organized by Policymakers and NGOs. Each agricultural equipment manufacturing plant should also recruit engineers specialized in the design and manufacture of agricultural equipment.

Table 24. Existing bottlenecks in the links between actors (by category of actors)

Bottlenecks	Local manufacturers	Policy-makers	NGO-Experts	Suppliers of raw materials	End-users	All actors
Difficulty of access to credit with MFIs	70%	100%	100%	100%	50%	75%
Corruption and misappropriation of funds in the collaboration between Policymakers and NGOs.	60%	100%	0%	100%	100%	68.75%
Difficulty related to the repayment of loans received from MFIs due to market access problems.	60%	50%	100%	100%	0%	56.25%
Unannounced and disruptive visit of tax and duty collection officers.	50%	50%	0%	0%	0%	37.50%
Surcharge of tax duties and fees by the tax collection agents.	50%	50%	0%	0%	0%	37.50%
Weak technical and financial support for manufacturers, mechanics, etc. from Policymakers and NGOs/TFPs.	50%	50%	0%	0%	50%	43.75%
Manufacture of lower quality equipment that does not fully meet the needs of users	20%	0%	0%	100%	100%	31.25%
Difficulty of access to quality raw materials	20%	50%	0%	100%	50%	31.25%
Insufficient practical sessions in training centres	20%	50%	100%	0%	0%	25%
Lack of skills	20%	0%	100%	0%	50%	25%
Difficulty of access to the market	20%	50%	0%	0%	0%	18.75%

Bottlenecks	Local manufacturers	Policy-makers	NGO-Experts	Suppliers of raw materials	End-users	All actors
Inexistence of a control body for the local equipment produced	20%	50%	0%	0%	0%	18.75%
Difficulty recognizing formal manufacturers from informal	10%	50%	0%	0%	0%	12.50%
Difficulty related to the payment of taxes due to market access problems	10%	0%	0%	100%	0%	12.50%
Decrease in the price of locally produced equipment by customers	20%	0%	0%	0%	0%	12.50%
Difficulty for manufacturers to access information on tenders	20%	0%	0%	0%	0%	12.50%
Lack of modern equipment manufacturing tools	0%	0%	100%	0%	50%	12.50%
Difficulty for policymakers to control activities of informal manufacturers	10%	0%	100%	0%	0%	12.50%
Non-respect of the State's financial requirements towards trainers	0%	50%	0%	0%	0%	6.25%
Lack of regular training of manufacturers, end-users	0%	50%	0%	0%	0%	6.25%
Competition between importers and local manufacturers	0%	0%	0%	100%	0%	6.25%
Insufficient collaboration between NGOs, Policymakers and research	0%	0%	0%	0%	50%	6.25%

Bottlenecks	Local manufacturers	Policy-makers	NGO-Experts	Suppliers of raw materials	End-users	All actors
Lack of competence in the use of equipment by end-users	10%	0%	0%	0%	0%	6.25%
Piracy of equipment by informal manufacturers	0%	50%	0%	0%	0%	6.25%
Corruption by private intermediaries concerning tenders	10%	0%	0%	0%	0%	6.25%
inadequate after-sales services	0%	0%	0%	0%	50%	6.25%

Conclusion from Netmap sessions

Following previous developments, this study has enabled us to identify with stakeholders (local manufacturers, policymakers, NGOs/TFPs/projects, raw material suppliers, and end-users) who are critical to the local agricultural equipment manufacturing chain, using the Netmap approach. The tool also highlighted the existing bottlenecks in the links between actors and actions needed to regulate the activities of local manufacturers.

Thus, the different stakeholders that influenced local manufacturers were the manufacturers themselves and their associations, large private equipment manufacturing companies, end-users (producers, processors, breeders, etc.), NGOs/TFPs/projects and intermediaries/direct sellers, policymakers from national and local government, tax collection agencies, microfinance institutions, raw materials providers, researchers, trainers from private and public training centres

(high schools, universities, etc.), and other members of the private sector. Machine traders or resellers, welders-sheet metal workers, electricians, painters, turners, scrap metal workers, importers of machines and spare parts, students/learners, control agents for agri-food products, subcontractors (formal private companies and firms) were also mentioned. The different links identified between the actors were on transfer of competence/ capacity building/training, aid/ support/ assistance/donation/grant, advice/ extension by policymakers and NGOs, agricultural credit by MFIs; placing orders, scientific research, information exchange, partnership/collaboration/ assembling; business/money/exchange of goods and services; control of agri-food products, collection of tax duty by town councils and tax department; competition between small and large manufacturers, and importers of agricultural machinery.

End-users, small manufacturers, and large private equipment manufacturing companies were, in order of priority, the main influencers of the subsector. On the other hand, importers of machinery and spare parts, certification or control agents for agri-food products, national and local government policymakers were the least influencers. In spite of these collaborations, bottlenecks existed.

Bottlenecks affecting manufacturers

The main bottlenecks listed by the manufacturers, which weakened collaborations between the different actors were related to the non-compliance to the terms of production and sales contracts. Actions proposed by these manufacturers to remedy the problem were related to formal written contracts, including penalty for defaulting, as well as the willingness of each actor in the collaboration to respect the terms of the contract.

Difficulties in accessing credit from MFIs for the manufacture of agricultural equipment were also highlighted. The result shows that the problem can be corrected by facilitating access to credit following the reduction of interest rates, the easing of loan conditions and the guarantees required. The government and NGOs should also support MFIs with subsidies to facilitate access to credit for manufacturers and other direct actors in the manufacturing chain. The state should tackle discrimination in the granting of credit by making strict controls at the level of these institutions. Difficulties related to repayment of loans received from MFIs were also highlighted. It will be necessary to promote access to market by entrusting manufacturers with public procurement contracts, and organizing workshops and trade shows for the valorisation of local equipment so that manufacturers can have the necessary resources to repay loans.

Problems of corruption and misappropriation of funds at the level of collaboration between policymakers and NGOs were reported. Laws linked to heavy sanctions can be used in the case of non-compliance, to reduce incidences of corruption and embezzlement in government services. The government should also set up an external monitoring and control team at the level of service provision in order to reduce the scourge.

Also, weak technical and financial support for manufacturers, mechanics, etc. on the part of policymakers and NGOs/TFPs was reported. Regular technical and financial support to national policymakers, projects and NGOs for the development of high-performance local machines can be carried out. This support also includes advice and capacity building for the various actors in the manufacturing chain. The government should also develop a policy of subsidies to local artisans. Problems related to the surcharging of tax duties and fees by the town council and tax department were noted. As a solution, reduction of tax duties and fees should be carried out by policymakers to allow agricultural equipment manufacturing activities to develop. Also reported were the unannounced and disruptive visits by tax collection officers. There is thus the need to define a schedule for visits by tax collectors so that manufacturers can update their records before each visit.

Bottlenecks affecting policymakers

The main bottlenecks related to non-compliance with terms of production and sales contracts in the collaboration between manufacturers, customers, suppliers of raw materials, direct sellers and merchants, among others. It would be helpful to draft formal contracts between the players and the involvement of law enforcement agencies will ensure compliance with terms of a signed contract.

Difficulties in accessing credit from MFIs were also reported. To solve this problem, government support to facilitate access to credit at low interest rates and with lighter grant conditions can be provided. In addition, it is necessary to strengthen the partnership between policymakers and MFIs for more efficient credit services.

Problems of corruption and misappropriation of funds at the level of collaboration between policymakers and NGOs could be solved if strategy is established to reduce embezzlement. For example, implementers of the various projects in the sector can pre-finance such projects and be paid at the end of the implementation period after result verification by donors.

Bottlenecks affecting NGOs/TFPs/projects

Difficulties in accessing credit from MFIs for the manufacture of agricultural equipment were also reported, as well as difficulties in repayment of loans from MFIs due to market access problems. The lack of skills of certain actors (manufacturers, mechanics, electricians, etc.) was itself a bottleneck. This problem impacts on the quality of manufactured equipment; hence, categorization and registration of manufacturers (formal and informal) are required for follow-up and training. The government should also create a body to control the equipment produced in order to improve the quality of equipment on the market.

Furthermore, the lack of practical sessions in the training centres was highlighted. Thus, there

should be increased practical training sessions can help overcome this problem. The import of machines that do not meet the needs of users by ATDAs, NGOs and importers was also found. This constraint can be corrected by encouraging local production through technical and financial support from government. Local manufacturers should also carry out studies on customer needs before manufacturing the equipment.

Difficulties of policymakers in controlling the activities of informal manufacturers were underlined. There should be identification and categorization of all manufacturers (formal and informal) for regular monitoring and control. The government should also create a body to control the equipment produced locally.

Bottlenecks affecting raw materials providers

There were difficulties related to the repayment of loans received from MFIs due to poor market access. Others were the non-compliance with the terms of production and sales contracts during collaborations between manufacturers, customers, suppliers of raw materials, direct sellers, merchants, etc; inability to access credit from MFIs to purchase raw materials (spare parts, etc.); corruption and embezzlement at the level of collaboration between certain actors; and the manufacture of low quality equipment, which did not meet the needs of users.

For the difficulties in accessing quality raw materials (spare parts), there is the need for government's quality control with regard to raw materials (spare parts, etc). For the constraint related to non-payment of duties and taxes due to poor market access, there should be promotion and valorisation by government of locally manufactured equipment and financial support to local manufacturers.

Bottlenecks affecting raw materials providers

There were difficulties related to the repayment of loans received from MFIs due to poor market access. Others were the non-compliance with the terms of production and sales contracts during collaborations between manufacturers, customers, suppliers of raw materials, direct sellers, merchants, etc; inability to access credit from MFIs to purchase raw materials (spare parts, etc.); corruption and embezzlement at the level of collaboration between certain actors; and the manufacture of low quality equipment, which did not meet the needs of users.

For the difficulties in accessing quality raw materials (spare parts), there is the need for government's quality control with regard to raw materials (spare parts, etc). For the constraint related to non-payment of duties and taxes due to poor market access, there should be promotion and valorisation by government of locally manufactured equipment and financial support to local manufacturers.

Bottlenecks affecting end-users

Corruption and embezzlement at the level of collaboration between Policymakers (APRM, ATDA, etc.) and NGOs were affecting the quality of manufactured equipment. These can be remedied by building the capacity of local manufacturers through training, advisory and extension services by policymakers and NGOs. Agricultural equipment manufacturing firms should also recruit engineers specialized in the design and manufacture of such equipment.

Results from key informant interviews

Description of the state of the sector and the evolution of the sector concerning the manufacture of local agricultural equipment in Benin

The agricultural equipment manufacturing sector is growing rapidly in Benin. There are large, medium and small-scale manufacturers in both the formal and informal sectors. Most of these manufacturers specialize in the manufacture of postharvest equipment. The main companies in this sector are COBEMAG , LAMS , CEFACOM , Centre SONGHAÏ , BECRREMA , AFAS , CAMEMEC , CRTA , etc. These companies are modest in size and work in an artisanal or semi-artisanal manner. Only COBEMAG and centre SONGHAÏ are relatively large, manufacturing a wide range of agricultural equipment, especially postharvest equipment. As regard the processing of agricultural products, the most common local equipment are presses; maize, rice and soybean shelling machines, cassava grating machine, huskers, threshing machine, condiment mills, etc. Concerning the production, there is not much local equipment on the ground. Most of the pre-harvest equipment were imported. Production equipment were mainly animal-drawn cultivation. COBEMAG first adapted local equipment (plows, harrows) to tractors. The Agricultural and Food Technology Programme (PTAA) of INRAB has developed a lot of postharvest equipment, but which have not been widely disseminated due to internal problems relating to agricultural research.

For some of the actors, such as local manufacturers, financial institutions, producers' organizations, training institutions, etc., the local equipment manufacturing sector was gradually developing, as the number of manufacturers was found to be increasing daily, so that more actors in the agricultural sector were resorting to mechanization for the production and processing of products. "There is a lot of innovation and creativity in this field," said one of the respondents. Imported machines were excessively expensive, which means that most users could not afford them. Manufacturers were making efforts in this direction to meet the needs of local users. According to a representative of Knowledge and Skills Building Institutions:

Our centre is able to manufacture huskers, dryers, threshing machines, juice processing machines. It is only the tractors that we are unable to manufacture. However, we manufacture tractor parts and repair tractors...

For other actors, the sector is less developed. The head of a financial organization interviewed

said, *“To my knowledge, I know we have blacksmiths who make some animal-drawn equipment. In the local context, I do not see any particular development.”* Several reasons were given for the low level of development of this sector, both organizational and financial. According to the respondents, the local equipment manufacturing sector was not organized and structured, composed mainly of manufacturers not recognized by the state. Actors believed that there is no policy in this sector in Benin. Some of the producers’ organizations said: *“There is no policy for dissemination of manufactured machines; that is why this sector is not recognized throughout the country.”* Local decision-makers added that there were no standards for the manufacture of agricultural equipment in Benin. *“The equipment manufactured in Benin are not standardized at all because the equipment production sector is not organized.”* Some local manufacturers made machines without considering the required standards in terms of adapted raw materials, dimensions, etc. This has repercussion not only for the durability of the machines manufactured but also for the quality of the products obtained from these machines. *“It is important to comply with the standards, especially for health reasons,”* said a local manufacturer. Food processing equipment that should normally be made of stainless steel were made of other materials, such as iron or steel. As a consequence, the machine did not last and/or contaminated the finished products. The sector must therefore be disciplined enough to respect standards in quality machine manufacturing. For this, *“there should be an organization that controls and certifies locally manufactured machines,”* said a local decision-maker. Other reasons for the low development of the sector were the lack of finance to procure the means of production, and the lack of skills of some local manufacturers. According to a respondent, *“The development of this sector is slow because of the lack of financial means, as setting up requires the mobilization of large financial resources.”*

Moreover, manufacturers could not afford the costs of the needed raw materials and tools. For example, stainless steel, which is recommended for the manufacture of food processing equipment, was very expensive. A policymaking respondent stated:

You are expected to have the skill to produce these machines; yet, not everyone has that skill... Most manufacturers are blacksmiths trained on the job and do not have advanced technical training.

In the same vein, a producer respondent (member of a processors’ organization) put it this way:

Despite the efforts that manufacturers make, people still complain about the maintenance and quality of local equipment. I can’t call a manufacturer every day for maintenance on the equipment they sold to me. They don’t have the engineering skill at hand. They’re limited and don’t have the required mechanical skills.

This suggests the need for a policy document or support in the area of capacity building for local manufacturers.

The local agricultural machinery manufacturing sector in Benin evolved from craftsmanship. In the beginning, blacksmiths tried their hands on such agricultural tools as hoes, machetes, watering cans, etc. therefore, the sector evolved, due to the various training courses received from technical partners and the development of welding technology. The blacksmiths were able to develop by reproducing imported machines through projects and NGOs. The production activities benefited from the support of government and NGOs, as well as large manufacturing companies in neighbouring countries (Nigeria and Ghana, especially). With regard to what triggered the evolution experience, local decision-makers and manufacturers associations attributed it to the scarcity of agricultural labour during the major production periods. In this regard, respondent from manufacturer organizations stated:

It is because of inadequate human resources for rural activities that this sector has evolved. Indeed, the fact that children were expected to go to school meant that farmers no longer had adequate manpower in the farms. They therefore started thinking about alternatives to carry out agricultural operations on time within the challenge of inadequate agricultural labour. This is how they found the alternative of using machines.

For other actors, especially producers' organizations, the arrival of projects and programmes triggered the evolution of this sector. On this subject, an agricultural producer stated:

It is the demand for support from TFP/projects/programmes that made the sector evolve, because they very often encouraged the manufacture of machines. GIZ, for example, has financed processing cooperatives through the purchase of dryers and other equipment. This organization cannot always import this equipment, so it calls on local manufacturers.

There are a significant number of local manufacturers, colleges/technical schools (EPAC, INA, etc.) or training centres on the manufacture of agricultural machinery in Benin— "Every day, we notice new machines in the field," said a respondent of farmer-based organizations. There are also state structures, such as ANAMA that have been created to impact this sector. However, this evolution remains sensitive because of the constraints that the sector faces, among which is the difficulty in access to the means of production (raw materials and tools). Solutions must therefore be found for such constraints and measures must be taken to bring about true development in the sector.

Proportions of local and imported agricultural machinery used

Figure 2 shows the proportion of local and imported machinery used in the country. The data on all stakeholders show that the majority of equipment used in the processing of agricultural products (73.5%) was manufactured locally. In the area of processing, locally manufactured machines were more widely used than imported ones, due to their affordability and benefits from after-sales services. To this effect, an end-user organization stated that:

In Benin, most of the machinery used in agricultural processing are manufactured locally, because there are no adequate human resources to repair imported machinery. Therefore, users prefer local machines, for which repair labour is available. Also, local machines are cheaper than imported ones.

However, agricultural producers prefer imported machines, as they are more adapted to their activities and needs. In this regard, an end-user organization stated that:

Imported machines are highly valued and considered more suitable for agricultural production activities. Local manufacturers do not yet have the knowledge of the technology required to produce tractors, for example. They are still at a very early stage. The manufacture of pre-harvest equipment requires, for the most part, mastery of metallurgy and foundry, a sector of activity that is not yet developed in Benin or in the sub-region. However, they have recently started to produce seeders...

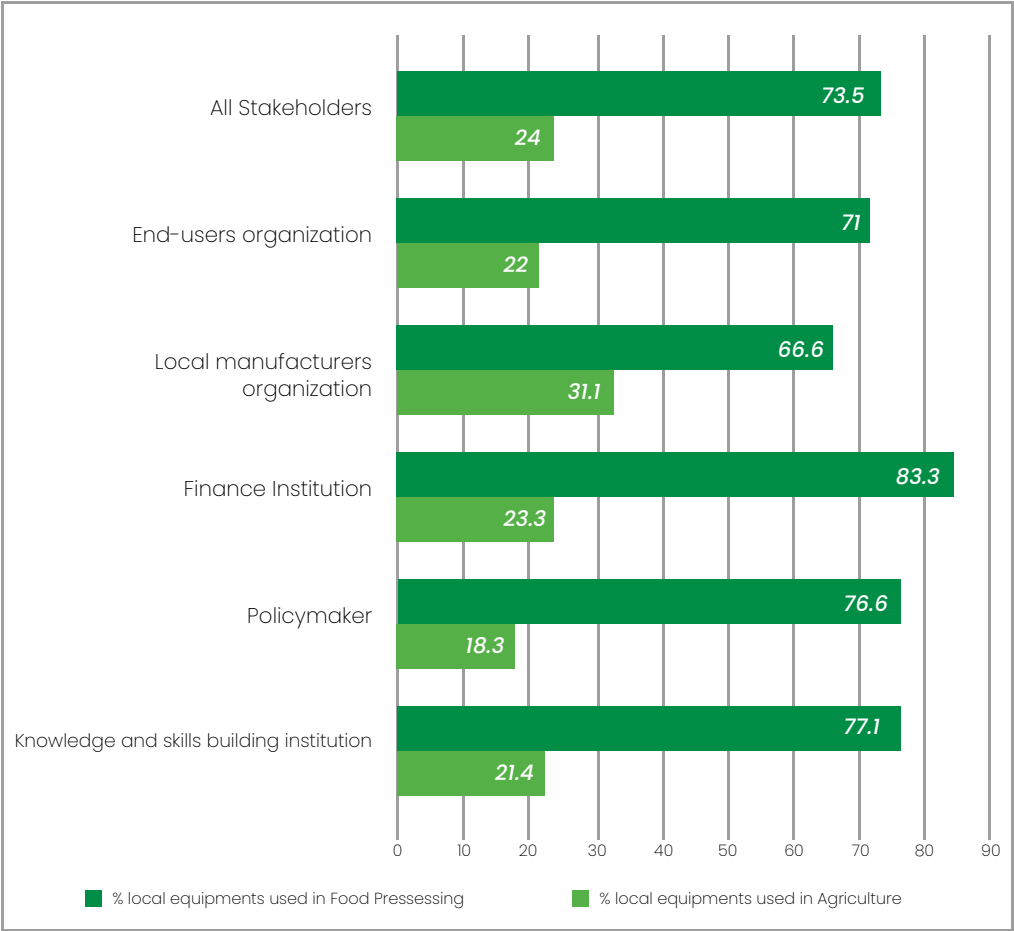


Figure 2: Share of locally produced and imported agricultural machinery used
Source: Results from key informant interviews, 2021

Stakeholders' perception of the role of agricultural equipment production sector in the future

Table 25 presents a prioritization of the major role of agricultural equipment manufacturing sector in the future of Benin agriculture. The Kendall's concordance test performed shows a significant W value at the $p < 0.01$ threshold. Thus, the prioritization is statistically concordant. Considering all the stakeholders, the data in Table 25 show that the main role is related to easy access to spare-parts and maintenance services for locally manufactured equipment; the manufacture of quality and efficient agricultural equipment that are adapted to meeting the needs of end users; and the promotion of the ingenuity (creativity) of local craftsmen. The valorisation of locally produced equipment, definition and implementation of state policies to facilitate the conditions of production and access; the motivation of young people and women in the agricultural activity to mechanize the process of production and processing were also major roles of the sector.

The aspect related to easy access to spare-parts and maintenance services for locally manufactured equipment was prioritized especially by the representatives of the knowledge and skills building institutions. In this regard, a respondent from this group stated that:

The opportunities in north Benin are immense. During the ploughing season, there is too much activity and spare-parts for imported ploughs are not easily accessible, and users are obliged to order from outside (Nigeria). Sometimes, after one or two weeks of use of these parts, one is obliged to change them, whereas ploughs produced by local manufacturers are more resistant, accessible, less expensive, and better mastered. There is enough imported equipment that are not used, because of the difficulties of access to spare parts. The administrative procedures to get the parts are also slow.

No one can achieve industrialization or increase production without mechanization. This is a growing sector in which the state can facilitate the conditions of production and access for actors to adapted equipment. In some areas of Benin, the possibilities of maintenance are available on the spot. This allows access to machines with limited resources. A respondent (head of a financial institution) stated during the interview:

I worked between 2008 and 2013 in the 2KP zone in Pehunco, and I can tell you that the majority of maize producers who sowed large areas had locally produced shelling machines. The use of shelling machines had developed so much with availability of maintenance ensured by COBEMAG which allowed all those who had little means to buy this machine. The machines cost around 300 or 400 thousand francs. This is an example of technology that has developed before my eyes and that has evolved because there was access to maintenance services.

One of the most important roles is related to the manufacturing of quality and efficient agricultural equipment that are adapted to meeting the needs of end-users. Policymakers showed the

importance of manufacturing machines that meet the needs of users in the development of agriculture and processing:

To limit the use of imported machinery, the state must necessarily finance research and development, so that researchers can develop machines adapted to the processing of our local products, and which meet the needs of the population.

Beyond the policymakers, local manufacturer organizations expressed interest in this role based on the gap between equipment demand and supply:

The main role of this sector is related to the manufacture of machines that meet the needs of end users. This is important because the machines made outside do not meet our realities. Agricultural products from outside are not necessarily the same as what we produce here. Soybean produced in China are not necessarily what is produced in Benin. There is necessarily a difference in terms of variety. To guarantee the future of this sector, we can resort to experts from foreign developed countries to come and manufacture machines adapted to our reality.

This sector has a promising future because we are in a consumer society, and the needs exist. Many oranges are produced and need to be processed, but we do not have the equipment to do so. It is only for pineapple that we have some equipment like the crusher, but the quality is still a problem at this level. So, we need to introduce standards so that what exists is of good quality. In some areas, there is local processing equipment that do not necessarily allow for the normal processing of the desired product. Either the equipment is not adapted, or it has shortcomings that can alter the quality of the finished product.

Furthermore, a respondent from association of women processors in Parakou gave her experience:

The machines manufactured are not really good yet; their quality is not either. I have bought machines from manufacturers. The one that processes cassava into gari is of very good quality. However, the manufacturers must build their capacity so that we do not grind several times to ensure that the crushed cassava is fine. We would like to have machines that can grind once in order to reduce expenses related to energy consumption. However, there are still many concerns regarding the soybean processing machine. So, we have to work on providing solutions to this problem.

The role of valuing or encouraging the ingenuity (creativity) of local artisans was raised mainly by policymakers, knowledge and skills building institutions, local manufacturer organizations, and farmers/ processors-based organizations. These organizations were aware of the ingenuity of grassroots actors and the importance of valuing these talents for the good of the sector. Some had proven themselves in the field. For example, a welding centre had produced presses from an

imported model. This valorisation of the know-how of actors should be valued and encouraged. According to some respondents in this category:

The sector has a big role to play if we want agriculture to help us. We need to produce the equipment and improve them over time, as needed. When the manufacturing process is a bit complex and difficult, some people get discouraged. I made a press, called Olea Press, inspired by an imported press that I saw at the monastery in Zagnanado, and some foreign experts saw and liked it. We can do great things...

We have ideas for machine designs, but we need funding to manufacture and use them, to see the shortcomings, and to correct or improve on them.

Beyond such factors of production as land and capital, ingenuity/creativity are critical to development. Experts from financial institutions interviewed presented the merits of valuing the ingenuity of actors and the role that the machine manufacturing sector plays in this sense.

The factor of production on which all nations are based, is linked to competence. If our craft does not modernize it is not good. We have been using the hoe for years. The materialization of the policy and the emphasis on capacity building of local artisans would raise their spirit of creativity.

The valorisation of locally produced equipment was relevant for all stakeholders interviewed. Valorisation was perceived to be capable of contributing to the development of the local economy. The sector could play this role if the state puts in place a system that encourages local production and purchase of local products instead of imported ones.

This sector has a promising future if the state supports it through the establishment of a framework or system that requires local consumption. If the state can subsidize or donate agricultural equipment to pineapple processing, for example, it would only put up tenders for local equipment, rather than imported equipment.

Efforts are made by several organizations to manufacture local machines or equipment. These productions generate income for the actors, and consequently the development of the local economy. The experience of NGO LAMS is edifying. Their machines contribute to the improvement of the local economy. If eventually the mechanization sector starts to be valued in Africa, the workers in the field will have a lot of income. There will be a lot of opportunities for the actors in the field.

For example, we are currently working on a tablet printer. This has never been done before in this field at the local level. So, we are working for the future. Moreover, thanks to the local manufacturing, the money stays in the country, and we don't need to go elsewhere to import machines.

A role that the sector can play is to contribute to the definition and implementation of state

policies related to the creation of an information system, to facilitate the conditions of production, and access of agricultural actors to adapted, efficient local equipment. This role is especially important for knowledge and skills building institutions, policymakers, finance institutions, and farmer/ processor-based organizations. A policymaker respondent noted that:

With the evolution of agriculture, this sector will have a major role to play. Our government must create conditions to facilitate the installation of manufacturers, extension, and the private sector in promoting equipment. The small equipment we see is copied from imported models. Despite their limitations, this helps. For example, mini rice mills are in serious need of machines.

The need for agricultural mechanization exists, and the state, in its role of supporting the sector, can facilitate the conditions of production and access of agricultural actors to appropriate equipment. This can be done by setting up an information system that would allow end-users to be better informed about the production sites of locally produced equipment. This can be done by public and private extension agents, associations of manufacturers, training centres, etc. In this regard, a local manufacturer stated that:

The population (users) is under-informed about what is being done in the field, and does not know the large manufacturing companies adapted to meet their needs. So they are forced to go to the informal sector. Sometimes, they prefer going to Nigeria, because they know that there they can easily find these machines to buy. It is therefore necessary to put in place an information system that will allow users to know where to find suitable and efficient equipment.

On the other hand, some users are willing to purchase machines, but do not have the financial means to do so. The same is true for manufacturers in the purchase of raw materials for the production of machines. A respondent had said: "This sector will make it easier for farmers and processors. I know processors who are talented and make soap, but they don't have money to pay for the mould and mixer."

The motivating role of youth and women in agricultural activity, to mechanize the production and processing process, was relevant to farmer/ processor-based organizations. This could allow them to increase yields, which promote women's empowerment and reduce the unemployment rate. One of the farmer/processor-based organisation respondents said:

I think that this sector has a promising future, because it is first of all a source of self-employment that allows to reduce unemployment. Those who are in the field manage to be self-sufficient. For example, the company ASAFMA gathers a lot of young people who are motivated and make innovations, and does not lack market.

In addition, a financial institution respondent stated that:

The sector has a promising future because, as I said at the beginning, buying imported machines was a myth for some. But when young people saw local machines working, they understood that it works well, so they started to resort to mechanization. So, I believe that if there is a good extension policy and good promotion of this equipment with subsidies to reduce the cost of acquisition, this could motivate young people.

Moreover, this sector has the role of arousing the passion to increase agricultural production, because the machines for transforming agricultural products cannot be useful if agricultural production is not developed. This role was more critical for the knowledge and skills building institutions and policymakers, who indicated in their responses thus:

This sector will therefore prosper, provided that agricultural production is supported. We cannot have processing machinery without having a given quantity of products to process. Today, we have stocks of corn that are rotting due to the lack of effective conservation methods. We must therefore think about this before supporting the manufacture of machines.

We do believe that this sector has a promising future, given the fact that agricultural labour is scarce. Moreover, in the next few years, this need will increase even more, because the population is growing day by day, and everyone must eat. So, we will need to mechanize the sector in order to have a real development. It is therefore necessary to work on professionalizing the different actors of the sector.

The role of helping to solve labour availability problems is most evident for farmer/processor-based organizations. There is increasing unavailability of labour during agricultural seasons. Young people prefer to engage in other activities, such as selling gasoline, driving motorcycle taxi or going to Nigeria to fend for themselves. Thus, the agricultural equipment manufacturing sector could contribute to providing a solution to this hard-to-find labour force.

People are looking to mechanization because labour is no longer available. Many people used to leave their villages during harvest and plowing for off-farm activities. But now they stay in their villages because they can use local equipment.

Capacity-building is the basis for development. In the field of mechanization, beyond the need for financial and material support, actors need training in order to effectively carry out their activities. The equipment manufacturing sector can be the ideal framework for adding to the know-how of actors. In terms of results, the knowledge and skills building institutions and finance institutions considered capacity building of artisans in the sector to be a major role. The procedures and efforts made in this area by the state were presented by respondents in this category:

There are technicians who have gone abroad to be trained, and will return to train others. This will increase the number of manufacturers in the future. With the reorganization of

the sector by the state, manufacturers will be better trained and will be able to receive trade qualification certificate (CQM).

If we build the capacity of local artisans, I think they can do a lot more. Currently, they are left to their own devices. They need support. For example, there are NGOs that help women install shea-butter processing machines for crushing and grinding, which reduce the difficulties encountered by women in this field.

The role of reducing time and difficulty in agricultural operations was less decisive, compared to the others. Nevertheless, some stakeholders gave their views on this topic. In the field of agriculture, the use of hoe, daba and machete is becoming increasingly outdated. The arduousness of work and slowness in the execution of tasks cause young people to forsake agriculture for other activities. In the transformation, the observation is the same. Mechanization is a tool that can reduce the time and effort involved in agricultural operations. The following was made at one of the survey interviews with local manufacturers:

I think this sector has a brighter future for our country, the manufacturers and the users. If I take, for example, the transformation of a hectare of gari, it can take almost two weeks if it has to be done manually. But with the agricultural machines, even in one day we can finish it. These machines allow us to reduce the time and effort of agricultural operations. This allows to improve the national production. Likewise, if I take the example of peanuts, we used to remove the shell by hand, which took days to make a bag. But thanks to the machines, in a few hours, a ton of peanuts can be processed in less than a day.

If I take the example of my father who has a lot of land, it was really difficult to plow. It took us several days. But when we started using the power tiller, in one day we could do the work that many people could do. Moreover, we obtained good yields.

The role of facilitating the exchange of skills between local and foreign artisans was also less important. Nevertheless, some stakeholders gave their views on the subject. In the field of mechanization, as in many other technical or mechanical fields, the exchange of skills between local and foreign artisans helps build the capacity necessary for sectoral development:

The sector will prosper because nothing has been done yet in the agricultural field. However, it will be necessary for the manufacturers to unite, and to put together the means and the knowledge in order to realize complex equipment. There is too much individualism in the sector, which means that the sector has not yet taken off.

Moreover, machines more complex than the local ones have already been developed in the developed countries. So the machines that will solve our problems already exist. Those who will have to manufacture these machines at the local level will be able to draw inspiration from what is done outside, they can exchange knowledge with foreign experts

Table 25. The role that the agricultural equipment manufacturing sector will play in the future

	Knowledge and skills building institutions	Policymakers	Finance institutions	Local manufacturer organization	Finance institutions	All stakeholders
Facilitating access to spare parts and maintenance services for local equipment	1.71 (1)	3.33 (2)	3.33 (3)	2.22 (2)	3.6 (3)	2.67 (1)
Promoting the manufacture of quality and efficient agricultural equipment adapted to and meeting the needs of end users	1.71 (1)	3.33 (2)	2 (2)	1.78 (1)	7.2 (6)	3 (2)
Valorising or encouraging the ingenuity of local Artisans	4.86 (4)	3.5 (3)	8 (8)	4 (4)	5.2 (4)	4.7 (3)
Valorisation of locally produced equipment	6.57 (5)	5.17 (4)	3.67 (4)	3.44 (3)	3.6 (3)	4.57 (4)
Definition and implementation of state policies to facilitate production and access conditions	4.14 (3)	2 (1)	1 (1)	8.78 (9)	6.6 (5)	5.2 (5)
Motivation of young people, women to agricultural activity, to mechanize the process of production and processing	9.43 (8)	8 (7)	6.33 (6)	6.33 (6)	1.8 (2)	6.63 (6)
Boosting national agricultural production, diversification of speculations and processed products	2.86 (2)	6.17 (5)	10.83 (11)	7.5 (7)	9.6 (9)	6.83 (7)

	Knowledge and skills building institutions	Policymakers	Finance institutions	Local manufacturer organization	Finance institutions	All stakeholders
Contribute to the resolution of workforce availability Issues	9.86 (10)	7.5 (6)	7.83 (7)	8.89 (10)	1.2 (1)	7.45 (8)
Facilitating capacity building of the sector's artisans	6.71 (6)	8 (7)	5.67 (5)	7.61 (8)	9 (8)	7.52 (9)
Reduction of time and effort in agricultural Operations	9.71 (9)	10 (9)	8.33 (9)	5.78 (5)	7.4 (7)	8.07 (10)
Facilitating the exchange of skills between local and foreign artisans	8.43 (7)	9 (8)	9 (10)	9.67 (11)	10.8 (10)	9.37 (11)
Number of observations	7	6	3	9	5	30
W of Kendall	0.896	0.659	0.901	0.702	0.924	0.415
Ch2 (10)	62.701***	39.515***	27.026***	63.148***	46.182***	124.4***

Opportunities for agricultural equipment manufacturing sector

Table 26 presents a prioritization of the main opportunities for the sector regarding agricultural equipment manufacturing. The Kendall's concordance test performed shows a significant W value at the $p < 0.01$ threshold. Thus, the prioritization made is statistically concordant. Considering all the stakeholders, the analysis shows that the main opportunities in the sector are related to the existence of a consumer market for local agricultural machinery and spare-parts, the modernization /facilitation of the production process and job creation. The political will of the state to organize the agricultural equipment manufacturing sector, the development of local skills in the design, manufacture and maintenance of agricultural equipment, and the opportunity to benefit from an after-sales service for this local equipment also appear to be key opportunities for the stakeholders interviewed.

One of the biggest opportunities for this sector is the existence of a consumer market for local agricultural machinery and spare-parts. This appears to be the main opportunity for all stakeholders. For them, this consumer market exists because of the ease of access to these machines and spare parts that meet the needs of end users (in terms of availability and cost), compared to imported machines. Thus, local production is valued, which facilitates the creation of wealth for the country (development of the economy). Local manufacturer organizations have stated that requests for equipment or even machine repairs are becoming more frequent, as the use of manual force is becoming obsolete for both producers and processors. They are aware of the advantages that the use of local machinery gives them and therefore open to the possibility of affording them. To this effect, a representative of the Local manufacturer organization declared that:

We have opportunities to achieve significant turnover not only on sales, but also on the production of spare parts and maintenance services.

From the point of view of knowledge and skills building institutions, the market is developing. In the awareness of the demand for machines by producers, the number of learners who enrol in technical courses has increased significantly. Thus, they stated:

If local equipment are well presented, there are many producers who will be interested. Even if they can't afford it, some of them will form a cooperative to buy, and do serious work." Knowledge and skills building institutions

One of other opportunity of this sector is related to modernizing/facilitating the production process. This was prioritized by representatives of the farmer/ processor-based organizations, local manufacturer organizations and policymakers. According to these stakeholders, the modernization and facilitation of the production process will allow for the development of agricultural production, animal husbandry, processing and the diversification of the crops

produced and processed, given the reduction in the working time of producers/processors and the increase in the quantities produced. The quality of the finished products resulting from the processing, storage and conservation (reduction of the post-production loss rate, for example) will also be improved compared to artisanal methods. The Farmer-processors based organizations are getting used to the use of agricultural machinery. From experience, they know the advantage that these machines provide. In this regard, one of their representatives said: *“An obvious difference is observed between manual work and the use of machines.”*

The local manufacturer organizations, on the other hand, state that agricultural machinery has a significant and important impact on agricultural production. According to these local manufacturer organizations, the introduction of machinery is essential to keep up with new agricultural and processing practices. These machines reduce the use of physical force and facilitate agricultural production and processing activities.

Finding manpower has become a problem due to the rural exodus, the schooling of young people, etc. Machines have become essential in motivating the sector's actors (producers, processors, producer and processors associations) to mechanize the production and processing of agricultural products. Machines have become essential in motivating the sector's actors (producers, processors, producers' associations and processors) to mechanize the production and processing of agricultural products.

Policymakers, under the influence and constant pressure of these and other actors directly involved in the sector, have begun to take more action in this direction in order to facilitate production and processing activities and to allow the introduction of new technologies in the sector.

Another major opportunity for this sector is related to job creation, which has been highlighted by the Knowledge and skills building institutions, the Local manufacturer organizations and the Farmer/ processor-based organization. Indeed, the increase in demand for machinery (markets) could lead to an increase in the number of local artisans and other actors (mechanics, metal turners, electricians) involved in the manufacturing process of agricultural machinery. All this would contribute to the reduction of unemployment, the development of crafts, the promotion of self-employment and entrepreneurship of youth in agriculture to boost the sector . On this subject, the head of a Knowledge and skills building institution and a representative of the Farmer/ processor-based organization interviewed argued as follows:

There is a significant increase in the number of students enrolled in engineering programs. Many of them are self-employed after their training when they are not already employed in local companies, thus creating employment for themselves, but also for others...

Many jobs are being created over time. There is a definite increase in the number of workers within this sector as many people place orders for machines as they need them. Still others are putting a lot of demand on the technicians for repairs and other

services.

To further promote job creation, some measures have been defined in the National Strategy for Agricultural Mechanization (SNMA) in order to facilitate the creation of businesses in the sector, giving the opportunity to many people to get out of their unemployment situation, said a policymaker.

The opportunity related to the political will of the State to organize the sector concerning the manufacture of agricultural equipment was prioritized especially by policymakers, heads of financial institutions and knowledge and skills building institutions. In this regard, head of a financial institution stated:

We think that the agricultural equipment manufacturing sector must be organized. It is necessary to be able to identify each actor of the sector. It is necessary to know who is a processor, who is a formal and informal manufacturer of machinery, who is an importer of machinery. So before the state commits funding to the sector, we proposed that it conduct surveys to identify and categorize each group of actors so that we can know the different actors in the sector.

However, the local manufacturer organizations were concerned that leaders are relying too much on machine orders from abroad, to the detriment of the local manufacturers, who still feel that they have the skills to provide the machines and the services locally. The farmers/ processor-based organizations shared this opinion on local manufacturing and thought that leaders were less engaged in the sector; and that their decisions were not favourable to the sector, especially with regard to credit and/or subsidies to the sector.

The development of local skills (design, manufacturing, and maintenance) was emphasized by the knowledge and skills building institutions and policymakers. For these stakeholders, this development of local skills would promote the availability and increase the number of specialists in agricultural equipment and avoid the need for external consultation. To this end, knowledge and skills building institutions make a point of providing quality theoretical and, above all, practical training to their learners. As the head of a knowledge and skills building institution pointed out:

Whoever is trained here or has set up his workshop, as more machines come from outside, he will seek to better copy those machines, thus reducing the periods of long wait for foreign know-how and expertise.

Policymakers are committed to developing local skills by investing in the provision of equipment and human resources (trainers and foreign partners) to provide quality training to actors of the sector. In order for their work to be effective, specialists in the field must be able to acquire the necessary skills.

The opportunity to benefit from after-sales services (training, follow-up, and maintenance by manufacturers to users) also represents one of the best opportunities for the agricultural equipment manufacturing sector. According to the results obtained, the Farmer/ processor-based organization, the Policymakers and especially the Local manufacturer organizations are those who have prioritized this opportunity the most. In this regard, the local manufacturer organizations claim to have the necessary skills to offer quality after-sales service. Some of them have been providing their equipment with warranty, and are better able to repair it, unlike those who prefer to copy imported machines thinking they can repair them better. Local manufacturer respondents stated that:

Locally produced machines can be repaired here, sometimes free of charge thanks to the warranty and after-sales services we provide.

For the farmer-processor-based organization, this after-sales service is very important for the maintenance, follow-up, and durability of local machines. Technicians are often unable to repair imported machinery because they do not understand how it works and are faced with the unavailability of spare parts. To remedy this, policymakers such as the Food and Agricultural Technology Programme of Institut National des Recherches Agricoles du Bénin (PTAA / INRAB) help by playing their role as facilitator as best they can. They also provide support by organizing technical trainings and materials for practical tests in schools and training centres, thus enabling local manufacturers to have the necessary knowledge to manufacture and/or repair the machines. According to the qualitative data from policymaker respondents:

Locally manufactured machines are better mastered by local users. We have the advantage of having local after-sales service. For what is manufactured locally, you don't have to go out and get outside resources to repair the machines.

The opportunity to improve the working and living conditions of the agricultural equipment manufacturing sector is more evident for local manufacturer organizations, farmer/ processor-based organizations and knowledge and skills building institutions. Indeed, the local manufacturer organizations are convinced that if machine orders continue to increase, they could earn enough money to reinvest in satisfying their needs. This would contribute to their development, the improvement of their income, the balance and stability of their households and the good education of their children. The Farmer/ processor-based organization also showed the interest of this sector by declaring:

Having the right machine at the right time to do the production work will allow us to work better and more to guarantee good yields and thus improve our living conditions. (A representative of farmer-processor-based organization)

The development of this sector will increase agricultural production, which will increase the area planted, improve yields, promote agricultural entrepreneurship and boost our economy. (A representative of knowledge and skills building institution)

The opportunity for the increasing number and modernization of food processing industries in Benin was emphasized by policymakers and finance institutions. Indeed, thanks to the agricultural equipment manufacturing sector that is developing in Benin, Finance institutions are beginning to finance professionals in the sector for the creation or modernization of food processing industries. This opportunity could be seized by a multitude of people, especially young people, if the State provided more support to this sector. In this regard, a policymaker said: Building capacity to create and/or modernize industries is a topic at the heart of policy debates.

Increased provision of services and machinery rental (e.g., during the harvest) is also seen as an opportunity in the sector. It was prioritized by the Finance institutions, the Farmers- processors based organization and the Knowledge and skills building institutions. In fact, producers, processors, etc., often limited by their means to acquire machines, turn to the option linked to the demand for services from those who own machines. Access to local machines would limit the services and rentals provided by machine owners from neighbouring countries during major production campaigns. A respondent from the farmer/processor organisation stated that:

Some producers or processors buy local machinery and provide services to others who do not have equipment.

Financial institutions also stated that they were solicited by many producers for loans, in order to have the services of local and/or foreign tractor operators. Other requests are also for credit for the purchase of machinery for personal use, but also for service offers, in order to earn more and be able to pay back quickly. The development of the sector concerning the manufacture of agricultural equipment could therefore further encourage the emergence of these types of activities.

The possibility of exporting to the sub-region is a less obvious opportunity compared to others. Nevertheless, some stakeholders have given their assessment on this subject, particularly the actors most concerned by this sector, namely the local manufacturer organizations. In effect, these organizations are convinced, despite the many difficulties, that locally manufactured machines could be exported to the sub-region because of their quality. Some companies (COBEMAG , for example) have had to export their machines produced to some users in neighbouring countries who were interested in their services. Data from local manufacturer organizations show that:

There are also export opportunities in the sub-region (Senegal, Mali and Burkina). If we take for example the shea compress machine, it is COBEMAG who made the graphic design and the design of these machines (the crusher, the press, the cassava grating machine). COBEMAG was able to export these machines to Mali in 2019.

Other actors also gave their opinion on this subject, in particular the head of a knowledge and skills building institution: The machines manufactured in Benin can be exported to other countries

in the sub-region if we manage to improve the sector and especially the skills of our technicians. The possibility of payment in instalments to facilitate the acquisition of agricultural machinery is also a less obvious opportunity compared to others. However, some stakeholders have given their assessment on this subject. Indeed, there is a real need for equipment, but due to a lack of resources, producers and processors are unable to buy it. In this regard, a policymaker stated that many machines have been allocated to producers through this approach. Even today, discussions are oriented in this direction in order to allow producers to easily acquire the machines through subsidies or payments in instalments. In line with this, a representative of a finance institution interviewed said:

With the creation of a good agricultural bank available through the government or the private sector, farmers could acquire machinery by paying in instalments. Cash payment would limit access especially to small users.

The possibility of partnering with foreign experts (the Chinese, among others) for the purpose of transferring skills to local manufacturers is the opportunity least prioritized by the various stakeholders we met. To this end, some of these stakeholders gave their assessment of this opportunity. The farmer/processor- based organization asserted that this could result in expenses and proposed the following:

Instead, the funds should be made available to local technicians to allow them to reveal express their know-how.

Local manufacturer organizations concurred with the latter by stating that:

Policymakers should focus instead on the many experts present in our country and provide them with the necessary means to invest more in the sector instead of calling on intellectual resources from outside.

On the other hand, policymakers did not necessarily reject the idea of partnering with foreign experts, who they believed could be a good alternative. But there were also many important experts at the local level whose knowledge could be used.

Table 26. Opportunities for the local machinery manufacturing sector

	Knowledge and skills building institutions (%)	Policymakers (%)	Finance institutions (%)	Local manufacturer organization (%)	Finance institutions (%)	All stakeholders
Existence of a consumer market for local agricultural machinery and spare parts	1.43 (1)	2.33 (2)	1 (1)	2.11 (1)	1.6 (1)	1.8 (1)
Modernization/Facilitation of the production process to allow the development of agricultural production	4.71 (4)	3.17 (3)	6.67 (7)	2.44 (2)	1.8 (2)	3.43 (2)
Job creation	1.86 (2)	8.5 (8)	10 (10)	4.11 (3)	2.8 (3)	4.83 (3)
Political will of the State to organize the sector	5.14 (5)	1.5 (1)	3 (3)	9.89 (10)	7 (6)	5.93 (4)
Development of local skills	4 (3)	5.33 (4)	6 (6)	7 (7)	9 (10)	6.2 (5)
Opportunity to benefit from an after-sales service	8.29 (10)	7 (7)	7 (8)	5 (5)	7.6 (7)	6.8 (6)
Improvement of working and living conditions	7.14 (7)	9.5 (11)	9 (9)	4.89 (4)	6.2 (5)	6.97 (7)
Multiplication and modernization of food processing industries in Benin	8.14 (9)	5.67 (5)	6 (5)	7.56 (8)	8.8 (9)	7.37 (8)
Increase in service provisions and machine rental offers	7.07 (6)	8.83 (9)	2.67 (2)	10.56 (11)	3.8 (4)	7.48 (9)
Possibility of export in the sub-region	8.07 (8)	10.5 (12)	10.33 (11)	5.89 (6)	10.6 (12)	8.55 (10)

	Knowledge and skills building institutions (%)	Policymakers (%)	Finance institutions (%)	Local manufacturer organization (%)	Finance institutions (%)	All stakeholders
Possibility of payment by instalments to facilitate the acquisition	10.86 (11)	6.33 (6)	4.33 (4)	10.56 (12)	8.6 (8)	8.83 (11)
Possibility of partnering with foreign experts for the transfer of skills to local manufacturers	11.29 (12)	9.33 (10)	12 (12)	8 (9)	10.2 (11)	9.8 (12)
Number of observations	7	6	3	9	5	30
W of kendall	0.766	0.687	0.882	0.662	0.805	0.4
Ch2 (11)	59.013	45.359	29.103	65.513	44.262	132.122

Major constraints to the development of the agricultural equipment manufacturing sector

The local agricultural equipment manufacturing sector is an important sector for agricultural mechanization and consequently for the development of agriculture. Although efforts are being made by various actors in the sector, there are still several constraints. These constraints were identified and prioritized by knowledge and skills building institutions, policy makers, finance institutions, local manufacturer organizations and farmer-based organizations, and the results are presented in the Table 27.

The Kendall's concordance test performed shows a significant W value at the $p < 0.01$ threshold. Thus, the prioritization made is statistically concordant. The constraint linked to the lack of financial means to obtain materials (quality raw material, in this case stainless steel in the field), work tools, and transport for delivery to clients was the first to be identified by all the respondents, namely, policymakers, local manufacturer organizations and farmer-based organizations. For the local manufacturer organization, the difficulties of access to raw material prevent manufactures of equipment, as explained by the following response:

If our organization doesn't have the raw materials to make a type of machine, we don't make it. We have always preferred the use of sustainable quality materials to meet the demand, so we are not criticized in the market. We always mark the difference through what is served to the farmers. For example, a customer proposed us to manufacture a tool that will be used to collect almonds without touching with the hand to avoid snake bites. This requested equipment was manufactured in Asia. But as we did not have the financial means for the purchase of the raw material adapted for the production, we had refused to make this tool that was requested.

Another respondent states that:

In the manufacture of agricultural machinery, the most the important is not only strength, but there is also means. If there is a minimum of means for the purchase of raw materials, we will do great things.

The lack of financial means and subsidies from TFPs and the state was a real puzzle. Some representatives of knowledge and skills building institutions explain that they are sometimes obliged to pay for some raw materials by themselves before being able to carry out experiments related to manufacturing with the learners:

I am currently conducting an experiment with a student. He wants to make tomato puree dosing device. We are thinking about it, and I know that we will realize it. But for the acquisition of some raw materials, I am obliged to pay for them to help the student. Normally it shouldn't be like this. Not all researchers have the motivation to make these

investments.

The second main constraint for all the stakeholders is related to the low skill level of the actors in the field in the production and maintenance/repair of local machines. This low skill level is linked to the lack of experience of some manufacturers, a problem linked to the technical capacity of manufacturers, and a lack of qualified specialists/technicians for maintenance. Most manufacturers of agricultural machinery are less trained, and others are obliged to move to neighbouring countries to improve their knowledge. This is the case of some of the local manufacturer organizations we met:

We have a market for the products. This is not a problem for us. Many people leave the sub- region to come and buy agricultural machinery from us. This is the case of Togo, Côte d'Ivoire and Burkina-Faso. However, there are still many things that small manufacturers do not know in these countries. We have some basic knowledge because of the proximity of Nigeria, because we go there to acquire knowledge. The Nigerian manufacturers are more developed in manufacturing these machines.

For the farmer/ processor-based organization interviewed, the State must take its responsibilities.

The manufacturers have problems related to their skills. The state can subsidize the training of two to three formal companies outside of the country to upgrade, so that they transfer the skills acquired to the rest of the artisans here.

Standardization, standardization and certification of local equipment are also among the main constraints identified by knowledge and skills building institutions, policymakers, local manufacturer organizations and farmer-based organizations. These constraints persist because there is no competent institution for monitoring or tracing the equipment produced by the artisans. Also, many are in the informal sector and do not use the quality material required for the manufacture of food products for example. Consequently, problems related to the quality and durability of the equipment arise at the user level, as well as consumer health problems. According to a local manufacturer organization:

The state must establish monitoring and evaluation bodies for national manufacturers. It was our organization that won the gold medal for the best manufacturer of press for palm oil extraction. But afterwards, many artisans have pirated or copied the press that we produced, and they made small improvements to compete with us. Our country does not have yet a real means to control and limit the piracy of agricultural machinery. The state should therefore think about setting up a system to provide patents to innovators, in order to federate their efforts, so that it is beneficial to the users of the machines. Certification is also important because it shows the seriousness of the sector. As for the certification of machines such as the solar dryer, the pineapple processing machines, there is the DANA which came to look and certify what is done. But it is a long time that

nothing is done at this level.

Some manufacturers are reportedly operating at a loss given the unfair competition environment due to the lack of monitoring in the sector. Some local manufacturer organizations have had mixed feelings about the monitoring and certification constraint. A local manufacturer organization official stated:

The fact that the state does not come to control the quality of the manufactured machines and their conformity does not constitute a difficulty for us. I believe that what we do is not bad, we base ourselves on the shortcomings pointed out and remarks made by the users in order to improve the quality of the machines manufactured. If I take for example the condiment mill, we are all aware that the deposits of the metallic irons used in the production of the equipment end up in the condiments, and consequently in our organism. However, the sector is not organized to carry out this control.

The lack of organization of the actors in the sector, or the absence of a spirit of unity among the actors in the sector, is one of the constraints that persists in the sector. This constraint is explained by a lack of structuring of informal and formal artisans and a lack of cooperative spirit among the actors. It was mainly stated by the Knowledge and skills building institutions, the Policymakers, and the Farmer-based organizations. According to a policymaker interviewed:

To my knowledge, there are few formal manufacturing units (COBEMAG, Project Songhai). The majority of informal artisans do it themselves. Formal and informal manufacturers must unite, and synergize their knowledge to achieve innovations, benefit from training and credit opportunities, meet the existing need for machines because the demand is ever growing. This will motivate the government to take decisions for this sector, in order to limit imports of machinery. There is also a problem of organization at the level of turners, mechanics, electricians who work with manufacturers.

The difficulty of accessing credit and the conditions of granting it do not allow the actors to carry out their activities. Difficulty in accessing the development bank was mentioned. This constraint related to credit was especially relevant for the representatives of the Finance institutions, local manufacturer organization, knowledge and skills building institutions, and farmer-based organization.

They show how financing the sector remains a real driver for the development of the agricultural equipment manufacturing sector. According to the head of Knowledge and skills building institutions:

You can't give an entrepreneur 1 year to pay off these debts. You have to give them at least 5 years because the entrepreneur is not always able to pay the credits at the beginning of his activities. The credit offered by the FNDA follows similar process, and

is not adapted.

The poor technical (lack of training), financial, and promotional support for the actors (producers, manufacturers, mechanics) was mentioned by all the stakeholders. This constraint is reflected in the absence of subsidies for the purchase of equipment/production factors for machines by the state, the absence of promotion of local machines by the state, and lack of an extension system for local machines. Policymakers show that this constraint persists, because it would be difficult for the state to invest in a sector that is not organized. They show that the state will be able to invest in this sector if the actors unite, are categorized, and organized. A respondent stated:

It is the role of the State to organize the actors and the sector. It is necessary to identify each actor of the sector. It is necessary to know who is a processor, a machine manufacturer, a maintainer, and an importer of raw materials. It is therefore important to categorize them. After the categorization, it is necessary to organize the actors and the sector, to encourage the actors of the sector to form an association to participate in workshops, and to be able to benefit from important financing from finance institutions. There must be a functional relationship between these different actors. When the sector is not organized, it is difficult to invest money in it.

Several other constraints were mentioned by all the stakeholders. These included the lack of financial resources for end-users (farmers) to purchase machines or the low purchasing power of buyers, which leads to poor sales. This constraint also leads to an increase in the costs of renting or providing services to some small producers, by those who could afford the machines. According to a respondent:

Most farmers can't afford to buy farm machinery. If someone could afford it, he would rent it out to other producers at expensive costs.

Beyond the low purchasing power of buyers, the problem of satisfying the needs of users remains crucial and seriously inhibits the machine manufacturing sector. The quality of the machines made available to users by some manufacturers is poor. Several testimonies related to the dissatisfaction of the purchasers towards the quality of the products bought exist. On this subject, the statements of a policymaker are as follows:

I remember the corn shelling machines purchased by the PTMA from local manufacturers. There were poor quality shelling machines that were crushed by the corn itself. So there is a problem with the raw material used for production. This brings to be reluctant about buying from the local manufacturers. But I think that the structure which makes the quality products is the big formal units as the COBEMAG.

According to the farmer-based organization:

After a campaign of work, the local machines bought from manufacturers to shell soybeans, get spoilt very quickly. Especially the engines applied to these machines are not adapted, and do not last at all. Compared to the working tools, they are not of good quality, modern. There is also the problem of not monitoring the machines by the state, which negatively affects the perception of users of local equipment.

The other declared constraints are also related to the lack of follow-up of the machines sold by the manufacturers (after-sales service). Indeed, some manufacturers sell machines without instructing the users. In addition to the difficulty of accessing the machines given their expensive price, users also face poor quality of maintenance. A farmer-based organisation stated that: The machines are sometimes handed over to laymen who don't know how maintain them. The solution to this problem lies in the training of the actors. Indeed, training will allow them to improve the capacity of the machines. Nevertheless, there are some manufacturers who are persevering, and who improve things themselves.

The lack of knowledge among producers, processors of the different types of locally manufactured machines, and sales outlets was also a constraint for the manufacturing sector, although it is less of a concern. Also, some manufacturers were not aware of the sources of supply of raw materials and quality work tools. For managers of knowledge and skills building institutions:

There are modern production tools that manufacturers don't have access to, and there are also customs clearance fees that discourage them. They are not organized, so they can't plead for advantages.

Also, a gap was identified in the current training curriculum for learners. There is a lack of research programmes specialized in the manufacture of agricultural machinery; and there is no funding for research to facilitate the creation of innovations. The high cost of taxes also represented additional constraints to the development of machinery manufacturing centres.

Table 27: Major constraints to the development of the agricultural equipment manufacturing sector and reasons

Main constraints to the development of the sector regarding the agricultural equipment manufacturing	Knowledge and skills building institutions	Policymakers	Finance institutions (%)	Local manufacturer organization (%)	Finance institutions (%)	All stakeholders
Limited financial means to acquire raw materials and work tools	4.93 (5)	1.5 (1)	5.33 (5)	1.56 (1)	1.2 (1)	2.65 (1)
Low level of skills of the actors in the field in production and maintenance/repair of local machinery	2.71 (2)	2.83 (3)	1.33 (1)	3.33 (4)	3.4 (3)	2.9 (2)
Problem related to the standardization, certification of local manufactured or monitored equipment or traceability	12.9 (1)	2.67 (2)	11.33 (11)	3.06 (3)	2 (2)	3.22 (3)
Limited technical, financial and promotional support for the actors	3.57 (4)	5.67 (6)	1.67 (2)	5.67 (6)	3.4 (4)	4.4 (4)
Lack of organization of actors	3 (3)	4.17 (4)	9.33 (9)	9.22 (9)	6 (6)	6.23 (5)
Difficulty for users to access credit	7.29 (7)	17.67 (19)	3.33 (3)	2.94 (2)	7.4 (7)	7.68 (6)
Limited financial means of the farmers to acquire machinery	12.29 (12)	10.33 (10)	13.33 (13)	7.33 (7)	5.2 (5)	9.33 (7)
Problem related to the satisfaction of the user requirements	10.43 (9)	5.33 (5)	9.67 (10)	14.44 (14)	7.6 (8)	10.07 (8)
High cost of taxes; customs duties	8.29 (8)	15.17 (15)	15.33 (15)	4.67 (5)	14.8 (15)	10.37 (9)
Difficulty in accessing the market	12.79 (13)	11.67 (11)	5.67 (6)	10.89 (10)	10.6 (10)	10.92 (10)
Inexistence of specialized research programmes in the creation of innovations;	9.14 (9)	8.5 (8)	3.67 (4)	16.33 (17)	14 (14)	11.43 (11)

Main constraints to the development of the sector regarding the agricultural equipment manufacturing	Knowledge and skills building institutions	Polycymakers	Finance institutions (%)	Local manufacturer organization (%)	Finance institutions (%)	All stakeholders
Current learner training curricula not adapted to real requirements	11.14 (11)	9.33 (9)	11.67 (12)	15.33 (15)	12.2 (12)	12.27 (12)
Difficulty in accessing spare parts	7.14 (6)	15.33 (16)	7.67 (8)	18.11 (19)	12.8 (13)	13.07 (13)
Lack of monitoring of machinery sold by manufacturers (after-sales service)	18.57 (20)	7.83 (7)	17.33 (18)	12.22 (12)	10.6 (11)	13.07 (14)
Lack of control over the procurement of raw materials	13.86 (14)	12.67 (13)	13.67 (14)	17.33 (18)	8.8 (9)	13.8 (15)
Low level of energy availability	17.14 (18)	18.83 (20)	7.33 (7)	8.89 (8)	18.2 (18)	14.2 (16)
Unfair competition between agricultural machinery manufacturers.	16.29 (17)	16.33 (17)	16.33 (16)	10.94 (11)	16.2 (16)	14.68 (17)
Equipment hacking by informal manufacturers;	16 (16)	14.67 (14)	17 (17)	15.83 (16)	19.1 (20)	16.3 (18)
Lack of knowledge by producers, processors of the different types of local manufactured machinery, and sales outlets;	18.29 (19)	17.5 (18)	19.33 (19)	13.44 (13)	17.6 (17)	16.67 (19)
High cost of local machinery	15.86 (15)	12 (12)	19.67 (20)	18.44 (20)	18.9 (19)	16.75 (20)
Number of observations	7	6	3	9	5	30
W of Kendall	0.89	0.87	0.991	0.897	0,984	0.613
Ch2 (19)	118.329***	99.162***	56.467***	153.445***	93.508***	349.317***

Measures to consider by the public and private sectors, and farmer and manufacturer associations for each constraint

Table 28 shows for each constraint, measures to consider by the public and private sectors, farmers and manufacturers associations.

Table 28. Measures to consider by the private sector, Farmer and Manufacturer Associations, the public sector for each constraint

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Lack of organization of actors in the sector, or lack of unity between the actors of the sector, or poor structuring of informal and formal craftspeople, or weak cooperative spirit of the actors;	According to Knowledge and skills building institutions - Support associations of various actors in the field	According to Policymakers • - organize farmer associations to express actual needs	According to Policymakers • To clean up the environment by associating serious manufacturers who do good work; • Ensure unity among the actors.	According to Policymakers • Conduct surveys to identify and categorize each stakeholder group • Identify the different actors of the sector, then to put them in association for sharing experiences, for training purposes, for access to credits • Privatize the sector According to Local manufacturer organization • Organize stakeholders to enable knowledge sharing According to Knowledge and skills building institution • Identify the basic needs of each actor • Facilitate the organization of all the actors in the field. • Develop good policy for the sector and set standards for the sector • Supervise the sector

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Problem related to the satisfaction of the user requirements (Poor quality of the machinery made available to the users)	According to Policymakers - Organize training workshops According to Knowledge and skills building institutions - Network the manufacturers through NGOs and to follow this network so that machinery is manufactured in the standards. - Create structures for testing machines and providing feedback to manufacturers so that we know what needs to be improved	According to Policymakers - Express needs to get manufacturers to make quality equipment that meets their expectations - Contact experts in the field to find out what type of farm machinery is right for them - operation According to Knowledge and skills building institutions - Create workshops on the use of machinery for users	According to Farmer-based organization - join their skills in order to - provide users with good quality machinery - Use quality parts in the manufacturing of the machinery According to Policymakers - Offer quality services that meet the user needs - Strengthen their technical capacity with experts and major manufacturers	According to Policymakers Follow each step of the manufacturing process, the materials used for the manufacturing of these machinery in order to be convinced of the quality of the products

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Problem related to the standardization, certification of local manufactured or monitored equipment or traceability manufactured equipment	Local manufacturer organization - Seek means of regulation through subsidizing the formal sector and sensitizing buyers to go to formal manufacturers Policymakers - Provide craftsmen with technical data sheets of existing machines that have proven their worth		Policymakers & Knowledge and skills building institutions Ensure official recognition of manufacturers by the State	Policymakers & Knowledge and skills building institutions - Create decentralized structures to ensure the monitoring, standardization, and certification of local equipment - Lead ANAMA to ensure product standardization - Define the standards in collaboration with the rural engineering, INRAB, etc., and put in place a system to control these standards. - Regulate the field and even propose the types of agricultural machinery that should be purchased by users. - Support manufacturers in setting up a real production structure Local manufacturer organization - Establish decentralized monitoring and evaluate bodies for national manufacturers. They must evaluate and certify the equipment manufactured - Identify and organize manufacturers - Establish a roadmap for manufacturers - Stamped the machinery before they are put on sale. Knowledge and skills building institutions - Create a structure which must ensure the standardization, the monitoring of the manufactured equipment, to ensure its maintenance

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Current training curricula for learners not adapted to real requirements in terms of mechanization	Policymakers funding of training and research programs			Knowledge and skills building institutions Improve practical sessions in training centres
Low level of skills of the actors in the field in production and maintenance/ repair of local machinery	Policymakers & Local manufacturer organization: - Organize training workshops to encourage craftsmen to innovate Knowledge and skills building institutions: - Ensure the training of actors in the field - Provide actors in the field with qualified trainers - Train users of this machinery in small troubleshooting and its use - Create the national agency for agricultural manufacturing machinery. Farmer-based organization - Support the government in organize training workshops	Knowledge and skills building institutions - Play the role of facilitator to allow the actors in the field to be trained on the use of machinery. - Learn about the use of agricultural machinery through a partnership with training centres - Create knowledge sharing sessions between manufacturers - Convince themselves of the usefulness of farm mechanization on their farms; Local Manufacturer - Meet in an association and make suggestions on machinery. - Express their needs and expectations on machinery	Policymakers - Make follow trainings to the manufacturers and to deliver them technical sheets on the manufacturing of each machinery with the respect of the standards - Share experience of major manufacturers with colleagues Knowledge and skills building institutions - Develop networking systems so that everyone can contribute their knowledge and help the sector evolve - Remain in partnership with the CUMA, the ANAMA to make the manufacturers travel to allow them to touch other realities in order to adapt them to what is done here. - Facilitate idea exchange trips to acquire new technologies in the sector. - Work in synergy to share knowledge - Reflect together on problems of farmers in the field and seek contributions of addressing them; - Organize sections for upgrading, technology transfer - Follow the training courses correctly and consider the remarks and suggestions made by users Farmer-based organization - Use of the data sheets - Encourage top manufacturers to share knowledge	Policymakers - Public-private partnership for the organization of training workshops, bookkeeping, work planning - Train through INRAB the different actors in the sector, and support them so that they can innovate - Promote specialists in pre- harvest, postharvest, processing and breeding mechanization, etc. Local manufacturer organization - Organize capacity building workshops - Use experts from foreign countries to support local manufacturers in developing innovations adapted to our reality Knowledge and skills building institution - Organize capacity building sessions for maintainers with the help of external experts - Create a crucible for knowledge sharing - Organize training for manufacturers - Subsidize machinery manufacturers and short courses Farmer-based organization - Organize training workshops with local and foreign experts

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Limited technical (lack of training), financial, and promotional support for actors (producers, manufacturers, mechanics) (Lack of subsidies for the purchase of equipment/ production factors for machinery) by the State; Lack of promotion of local machinery by the State; Lack of an extension system for machinery manufactured in Benin	Local Manufacturer • Help to access quality training through NGOs • Help the government in its role of inspection Policymakers • facilitate access to the FNDA • Organize workshops and agricultural shows through NGOs to promote local machinery Knowledge and skills building institutions • Put in place a strategic plan to support manufacturers, and advocate with the authorities to support them • Create platforms, engage people, build capacity for manufacturers • Invest in training, funding (through grants/subsidies), Serve as a facilitator for manufacturers and their association with MFIs • Develop partnerships with research institutions, universities to be granted to students in order to promote their interest in the sector • Encourage manufacturers to label local machinery;	Farmer based Organisation • Encourage farmers to unite Knowledge and skills building institutions • Change your mind-set: don't always expect money after every training session. • Create a partnership with universities, research institutions, NGOs, to encourage the involvement of local manufacturers in the creation of innovations	Local manufacturer organization • Work together to improve the aesthetics of the machinery manufactured, and share knowledge Local Manufacturer • Create a training centre for sharing experiences and knowledge • join forces to serve the demand and meet the existing need of the machinery Knowledge and skills building institutions Organize to manufacture equipment that meets current standards. • Change your mindset: don't always expect money after every training. • Create formal groupings to promote access to credit, sharing of experiences by pairs of high-level manufacturers,	Policymakers: • Make more effort through the FNDA • Organize workshops or shows during which we will have to expose and sell products, advertise on radios, TV • Improve the slowness of public authorities in providing services and donations to the population • Provide credit and training Local manufacturer organization • Promote local machinery • Control the sector by stopping Asian competition Help manufacturers to label products. Why not write "made in Benin" on our products? • Establish a regulatory structure for the sector • Provide access to quality training Knowledge and skills building institutions • Subsidize the manufacturing of equipment. • Supply raw materials to manufacturers through small contracts • Invest in training, monitoring and certification or control of manufactured equipment • Grant subsidies in the purchase of production factors given the high cost of parts • Create agricultural banks to enable access to credit for all classes of manufacturers • To technically reinforce the trainers of the universities, the researchers

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
No research programs specialized in the manufacture of agricultural machinery. No research funding to enable the creation of innovations;	Policymakers Funding research and development			Policymakers & Knowledge and skills building institutions Financing research and development at the level of universities, high schools and research institutions
Low purchasing power of buyers of locally manufactured machinery;	Policymakers - Subsidy or donation of equipment or work tools to manufacturers Local Manufacturer organization - Subsidize the purchase of machinery - Make requests to the TFPs and credit providers in order to have access to credit Local Manufacturer - Mobilize resources for the actions (subsidy, acquisition of materials). - Set up local equipment processing units Farmer-based organization - Train and financially support the actors Knowledge and skills building institutions - Facilitate access to financing structures for credit for actors in the field	Knowledge and skills building institutions Encourage the development of groupings in order to pool resources to procure local machinery. This is done through the joint guarantee	Knowledge and skills building institutions encourage payment in instalments to facilitate user access	Policymakers - Subsidy or donation of equipment or work tools Local Manufacturer - Help producers to acquire equipment and pay in instalments; - Subsidize the purchase of machinery Knowledge and skills building institutions - Encourage the FNDA to facilitate the access of actors to credit - Creation of service centres with local machinery, for farmers who do not have the means

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Limited financial means to acquire materials (quality raw material, in this case stainless steel in the field), and work tools, means of transport for delivery to the customer;	Local manufacturer organization & Policymaker - Subsidize work tools - Public Private Partnership to facilitate the subsidy of quality raw materials - Facilitating access to credit Knowledge and skills building institutions - Advocate to governments to provide training centres with quality work tools	Local manufacturer organization & policymakers & Farmer-based organization privilege the purchase of local machinery over imported ones, in order to allow manufacturers to have the motivation and capital for manufacturing	Policymakers & Farmer-based organization make credit loans to the FNDA	Local manufacturers - Promote the availability of modern production tools or materials by creating specific sales centres - Farmer-based organization & Local manufacturer organization - Enable access to credit Policymakers - Facilitate the import of raw materials through the reduction of customs duties
Lack of control over the procurement of raw materials	Local manufacturer organization Promote the availability and subsidy in the purchase of raw materials and tools			Policymakers - Facilitate access to raw materials by creating specific sales outlets Local manufacturer organization: - Subsidize, create raw material sales centres
High cost of taxes				Local manufacturers - Review the tax policy towards agricultural companies by avoiding the application of VAT on agricultural machinery Knowledge and skills building institutions, - Reduce or exempt customs taxes related to the import of raw materials - Facilitate the transit of locally manufactured machinery to other countries in the sub-region
Difficulty in accessing the market;	Policymakers Organize workshops, shows to facilitate promotion		Local manufacturer organization & Policymakers - Use social networks, create catalogues to facilitate promotion	Policymakers Organize workshops, shows, to facilitate promotion

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
High cost of local machinery;	Policymakers Subsidize manufacturing	Policymakers Form groups to access agricultural credit to purchase machinery		Policymakers - Form groups to access agricultural credit to purchase machinery Policymakers - Subsidize manufacturing
Policymakers – Form groups to access agricultural credit to purchase machinery Policymakers – Subsidize manufacturing Difficulty of accessing credit by users (Difficulty in accessing development bank)	Local manufacturer organization & Local manufacturer organization The private sector can facilitate the access of credit from MFIs, FNDA.	Local manufacturer organization & Knowledge and skills building institutions Increase the frequency of purchase of local machinery by farmer associations to help manufacturers to have financial means, and not to rely on agricultural credit.		Local manufacturer organization & Policymakers & Local manufacturer organization - Intervene so that financial structures cannot apply the same loan conditions from traders to agricultural machinery manufacturers. Knowledge and skills building institutions - Set up MFIs adapted to agriculture or rather an agricultural development bank
Unfair competition between agricultural machinery manufacturers.			Local manufacturer organization: Share experiences and agree on the selling price of the machinery	
Equipment hacking by informal manufacturers;				Knowledge and skills building institutions - Establish a copyright - office for manufacturers

Main constraints	Constraints to consider by the private sector, and measures to address them	Constraints to consider by the Farmer Associations, and measures to address them	Constraints to consider by the Manufacturer Associations, and measures to address them	Constraints to consider by the public sector, and measures to address them
Lack of monitoring or instruction of users on the use of the machinery sold by manufacturers	Farmer-based organization Organize exchange visits with machinery users in order to collect their concerns and problems related to the use of the manufactured machinery	Farmer-based organization & Policymakers request machinery operating manuals from manufacturers	Farmer-based organization & Policymakers - Provide buyers with instruction manuals on how to use the machinery - To teach users how to use the manufactured machinery	Knowledge and skills building institutions - organization of user training sessions on local machinery - regular visits of extension agencies (ATDA)
Lack of knowledge by producers, processors of the different types of machinery locally manufactured, and sales outlets;	Local manufacturer & Knowledge and skills building institutions - Advocate to the government in addressing this problem - Extend local equipment to end users	Local manufacturer organization: Work together through the constitution of groups or cooperatives to make the equipment better known		Local manufacturer & Knowledge and skills building institutions & Policymakers Extend local equipment to end users

Discussion and Policy Recommendations

A variety of actors are involved in and directly or indirectly influence the manufacturing of agricultural equipment in Benin. Exchanges of goods and services; partnerships; technical and financial support from the private sector and decision-makers; tax collection; and competition between small and medium-sized manufacturers and importers are the main links between actors, making the sector dynamic. The sector is mostly made up of small companies, which are at the heart of the local equipment manufacturing chain. Nearly half of them are informal, confirming the study of IFDA (2008). The end-users, who are mainly producer-processors and breeders, are also crucial in the chain, as without them, the manufacturers would not exist. Almost all the companies had access to electricity grids, and more than 58% were officially registered, and belonged to an association, and paid taxes. However, studies conducted by Ampah et al. (2021) in Ghana showed that 33.9% of respondents had not registered their businesses with the Registrar General's Department. Most of the manufacturers had no knowledge of the manufacturing of renewable energy machinery. The same was true for having an e-mail address. There was not much promotion by catalogue, leaflet and website, due to lack of human and financial resources, or knowledge of these channels. This reflects somewhat the limitations and backwardness of manufacturers in terms of NICT (IFDA, 2008; FAO, 2008).

The manufacturing sector is gradually expanding, as the number of manufacturers and employees increases daily; and more producers, processors, and breeders are resorting to mechanization for the production and processing of products. Most of these manufacturers work in a traditional or semi-traditional way, copying models from other manufacturers, and specialize mainly in the manufacturing of postharvest equipment (condiment mills; presses; maize, rice, and soybean shellers; cassava grinders; hullers; threshers, etc.). The pre-harvest equipment produced and sold (seeders, harrows) is mainly adapted to plowing, and payment is often in cash or by bank transfer. The determinants of demand for local equipment are mainly related to quality, adaptation to local contexts, after-sales service, price, availability, reputation and trust. This result is consistent with Dene (2019) who shows that the selection of appropriate equipment is critical to competitiveness. Imported machinery are not within the reach of most users, thus, manufacturers then make efforts by creating innovations to meet the needs given the means of these local users. The sector has important roles to play in the future. The main ones are related to easy access to spare parts and maintenance services of local equipment. This allows, with few resources, access to and use of local machinery (Havard and Gaudard, 2018).

Problems related to maintenance would not arise, as locally manufactured machinery will be

better mastered by the manufacturers. Thus, there is an opportunity related to the existence of a consumer market for local agricultural machinery and spare parts. Enhancing or encouraging the ingenuity of local craftsmen would play a crucial role in the development of innovations, and the improvement of deficiencies related to the equipment produced. Building the capacity of local craftsmen would foster their creativity. In this way, new prototypes and machinery can also be introduced and tested to find the best solution or technique for specific tasks. These observations are consistent with those of FAO (2008). The valorisation of locally produced equipment would contribute to the development of the local economy. The sector could play this role if the State puts in place a system that encourages local production, purchase of local products instead of imported products, as efforts are made by several manufacturers to manufacture machinery. The State and the private sector should put in place an information system that will allow users to know where to find adapted and efficient equipment (Havard and Gaudard, 2018; Dene, 2019; De Animaw, 2016; PSRSA, 2011).

The opportunity to get from after-sales service is also one of the best advantages for the sector. These results are consistent with those of IFDA (2008), which shows that most of these manufacturers, when selling, provide users with access to spare parts, warranty periods, and emergency repairs when needed. The increase in service offers and machine rental (during harvest time, for example) also appears to be one of the opportunities in the sector. Access to machinery would limit the services and rentals provided by machine owners from neighbouring countries during major production campaigns. The possibility of exporting to the sub-region is an obvious opportunity if the sector is well organized and if the skills of technicians are strengthened. The motivation of young people and women to agricultural activity, to modernize the production and processing process through the use of local machinery, has been relevant insofar as they allow to boost national agricultural production, diversification of speculations and processed products. The saving of time realized thanks to this equipment now allows women processors to go to other social and/or economic activities (IFDA, 2008; SNeA 2019). This would promote food security, women's empowerment, the multiplication and modernization of agri-food processing industries, and job creation. These observations confirm the research findings of FAO (2008) and SNeA (2019). Indeed, the increase in demand for machinery could lead to an increase in the number of local craftsmen, the entrepreneurship of youth in agriculture to boost the sector. Ndindeng et al. (2015) and CORAF (2018) show that the introduction of the rice thresher and the galvanized parboiling drums introduced in West and Central Africa has boost the sector on fabrication of machines and transformation of cereals like rice.

In view of these various opportunities, progress remains challenging because of the constraints faced by the sector and of which the main one is related to the lack of financial means and access to credit to acquire means of manufacturing (raw materials in this case stainless steel, work tools, means of transport for the delivery to the customers). This is why machinery is often produced on demand, and customers often pay in advance. According to IFDA (2008), this denotes, thus, the restriction of the market for the sale of equipment and derived products, and perhaps also the low purchasing power of the potential users of said equipment (FAO, 2008). Policymakers believe

that the accessibility of agricultural banks should be strengthened with ATDAs by the public and private sector to facilitate agricultural loans. These measures have been defined in the National Strategy for Agricultural Mechanization (SNMA, 2021; PSRSA, 2011).

Manufacturers are also affected by local taxes, and environmental regulations. The low level of technical skills in the production and maintenance of machinery is an issue. Also, it was stated that there is a gap in the current training curricula for learners. Indeed, there is less practical session. This finding is consistent with Balse et al. (2015). There is less funding in the research programme by the private and public sector to facilitate the creation of innovations. This makes the problem related to meeting user needs in terms of equipment quality, remains crucial and seriously inhibits the sector. This result is consistent with Dene (2019) and IFDA (2008). Studies conducted by Safdar and Gevelt (2019) show that massive investment in local equipment research and development in China has strengthened their competitive position internationally, actively responding to changing consumer demands. Stakeholders believe that this constraint needs to be lifted by the private and public sector, and manufacturer associations for the purpose of organizing capacity building and experience sharing workshops, updating curricula and recruiting better teachers. The government is already making efforts in this direction by adopting a national agricultural mechanization strategy, creating ANAMA and the FNDA (SNMA, 2021; SNeA, 2019; MAEP, 2017; PSRSA, 2011). As for farmer and processor associations, they need to express their needs to improve what is being done. Also, a small proportion of manufacturers have accounting records, and the equipment manufactured is not at all standardized, normalized, approved or certified. Studies conducted by IFDA (2008) show that the size of the equipment manufactured is disproportionate among manufacturers. These constraints persist because there is a lack of unity among the actors in the sector, and there is no competent structure for monitoring the traceability of equipment produced by craftsmen. Also, many are in the informal and do not use quality materials required for the manufacturing of food products. For example, the processing equipment for food products that should normally be manufactured with stainless steel, are not. Instead, they use iron or steel instead of stainless steel. As a consequence, the manufactured machine does not last, and contaminates the finished product causing health problems for consumers.

The same observations were made by IFDA (2008) and Ampah et al. (2021). Stakeholders believe that the resolution of this constraint should be handled mainly by the public sector. IFDA (2008) shows that official recognition followed by structuring and organization of the sector's actors can lead them to benefit from tax exemptions and/or taxes on the purchase of materials used in the manufacturing of the said equipment, given the nature of the equipment produced and its interest in terms of added value for the national economy. Local and national government decision-makers have little influence on the field, as their level of technical, financial and promotional support is low. This constraint persists because it would be difficult for the state to invest in a sector that is not organized (IFDA, 2008; Dene, 2019).



Conclusion

This study first identified stakeholders (local manufacturers, policymakers, NGOs/PTFs, raw material suppliers and end-users). Through the Netmap approach, the different actors and networks of actors that are key in the local agricultural equipment manufacturing chain and existing bottlenecks in the linkages between actors and the measures needed to regulate the activities of local manufacturers. Second, the study allowed us to diagnose the local agricultural equipment manufacturing sector in order to better understand its functioning, and finally to collect stakeholders' perceptions on the status, roles, opportunities and constraints of this sector. Thus, from a stakeholder perspective, the various actors that influence the success of local manufacturers are manufacturers and their associations, factories, large private equipment manufacturing companies (COBEMAG , Project Songhai, etc.), end-users (producers, processors, livestock farmers), NGOs/PTFs/Projects, and canvassers or intermediaries Decision-makers from national government agencies (MAEP , MICPE , MESTFP , etc.), local government agencies (ATDA , DDAEP , etc.), tax collection agencies, microfinance institutions (CLOAG , CPMF , BOA , etc.), suppliers of raw materials (hardware stores, etc.), researchers (INRAB , IITA , etc.), teachers from private and public training centres (high schools, universities, etc.), traders or resellers, and the following were also mentioned: welders, sheet metal workers, electricians, painters, turners, ironworkers, mechanics, importers of machinery and spare parts, students/trainees, agri-food product certification or control agents (DANA , etc.), and subcontractors (small private companies and firms). However, end-users, small manufacturers and their associations and large private equipment manufacturing companies are the most important influential actors in manufacturing of local agricultural equipment.

The different linkages identified between the actors include skill transfer/capacity building/training, aid/support/accompaniment/donation/grants, extension advice by policy makers and NGOs, agricultural credit by MFIs, orders, research/scientific study, information exchange, partnership/collaboration/assembly, business/money/exchange of goods and services, verification/control of agri-food products, tax collection by city councils and tax authorities, competition between small manufacturers, large manufacturers and importers of agricultural machinery.

During all these collaborations, which were previously materialized by the different links between these actors, bottlenecks arose, the main ones listed by all the actors interviewed being related to the difficulty of access to credit by the actors (manufacturers, end users, welders, sheet metal workers, electricians, turners, iron workers and mechanics) from the MFIs; Non-compliance with the terms of production and sales contracts during collaboration between manufacturers, clients, raw material suppliers, canvassers and traders; corruption and embezzlement during collaboration between local decision-makers and NGOs; difficulty in having access to credit. Finally, there is little technical and financial support for manufacturers, mechanics, etc. from local decision-makers and NGOs/PTFs. Measures were proposed by each category of stakeholders to overcome each of these bottlenecks. With regard to the difficulty of accessing credit, all categories of actors wanted to facilitate access to credit by reducing interest rates and easing the conditions for granting

credit and the guarantees required. With regard to non-compliance with the terms of production and sales contracts, manufacturers, local decision-makers, and raw material suppliers proposed the establishment of formal written contracts and the involvement of law enforcement agencies if necessary to ensure compliance with the terms of signed contracts. The measures proposed by manufacturers, local decision-makers, raw material suppliers and users for corruption and embezzlement in the collaboration between local decision-makers and NGOs are respectively to pass laws with heavy penalties in order to reduce these phenomena, to put safeguards in place to reduce embezzlement, to fight against corruption and embezzlement within these structures, and finally to reframe the role of each structure in order to recreate the links between these structures. With regard to the difficulty of repaying loans received from MFIs due to market access problems, manufacturers, NGOs/PTFs/Projects and raw material suppliers respectively proposed facilitating access to the market by entrusting local manufacturers with public contracts, and also by organizing equipment trade shows. Finally, with regard to the poor technical and financial support provided to manufacturers, mechanics, etc. by local decision-makers and NGOs/PTFs, the measures proposed by the manufacturers themselves are regular technical and financial support for decision-makers at the national and local levels through projects and NGOs for the development of high-performance local machinery. This support also includes advice, training and capacity building for the various actors in the manufacturing chain. The State should also develop a policy of subsidies to local craftsmen.

From the diagnosis of the local agricultural equipment manufacturing sector, it was found that the manufacturers encountered were mostly those in the private sector. All of the manufacturers were exclusively men, and the majority became manufacturers by dream/vision. Most had basic welding training, but those in the public sector with government ownership had basic engineering training and a master's degree. When designing their equipment, they very often copy models from other manufacturers, and also use their own ideas for design. Some simply base their designs on ideas or requests from their customers. More than half of the local agricultural equipment manufacturing companies are officially registered and pay taxes, and belong to an association or organization. Most of the manufacturers we interviewed said they were involved in research and development, and would spend at least 4% of their annual revenues on this task. Locally manufactured machinery is mostly in the food processing and value-added field. Most manufacturers produce this machinery at the request of customers in order to reduce market risk, due to lack of capital, and to tailor the construction of the equipment to customer demand and preferences. And before starting the design of the machinery, almost all customers have to pay an advance. Considering the last twelve months, the equipment most sold by all the manufacturing companies we met are the direct seeder, the mill, the gin, the harrow and the press. The least sold equipment, on the other hand, is the fertilizer spreader, storage structures, incubator, grading machinery and clarifier. Not all the machinery sold is officially tested and certified by a state agency.

Furthermore, the renewable energy machinery manufacturing sector is not well developed in Benin, with only a few nationally owned private companies manufacturing renewable

energy dryers. Most manufacturers offer warranty services on all products sold and after-sales services to buyers. However, local policy makers and users claim otherwise. More than half of the manufacturers interviewed rarely keep records or have an accounting system. To advertise their businesses, the majority of manufacturers interviewed use word of mouth, advertising through showrooms, and social networks. The main payment method used by customers for the purchase of machinery is cash, and to a lesser extent bank transfer. The main competitors of the manufacturers interviewed are, in order of priority, manufacturers in the region, manufacturers outside the region, and machine importers. The main determinants of demand for local equipment for all manufacturers interviewed are, in order of importance, quality, local adaptation, price, and after-sales service. More than half of the manufacturers interviewed (55.3%) use the profits from the sale of equipment mainly for business investment and private use. In the last three years, the number of people employed by the interviewed manufacturers has increased to this day, and the majority of these employees have no basic training. Most manufacturers are not at all satisfied with the skills of the staff hired directly from school, and feel that the number of practical sessions should be increased in the educational system. Trainees are mostly identified through a formal application process and informal request from trainees. Some manufacturers still accept informal requests from parents/guardians. At the end of their internship, these trainees mostly go to work for other companies, or create their own company.

The majority of the manufacturers interviewed did not apply for loans because they felt they did not need them. However, others stated that they did not apply because of the tedious application process, the inadequate repayment schedule, or the many doubts about whether they would really receive the loans. In general, a few manufacturers received support from the government the previous three years. This support included knowledge and skills development, loans/credits, work tools, land, factory buildings, and free or subsidized electricity. Almost all equipment manufacturing companies had access to the electrical grid. Some policies and regulations negatively affected these companies. In order of priority, these were local and national taxes, environmental regulations, government competition through machinery imports, and import regulations. The majority of manufacturers rated the overall business climate as unfavourable in recent years. The main factors limiting the success of machinery manufacturing firms are related to access to inputs, access to financing, access to work tools, financing costs, market access, and personal injury due to lack of appropriate work tools. This sector is not organized. This affects not only the durability of the machinery manufactured but also the quality of the finished products obtained from this machinery. It should therefore have an organization that controls and certifies the locally manufactured machinery. In general, the sector has made progress, yet this progress remains challenging because of the constraints faced in this sector.

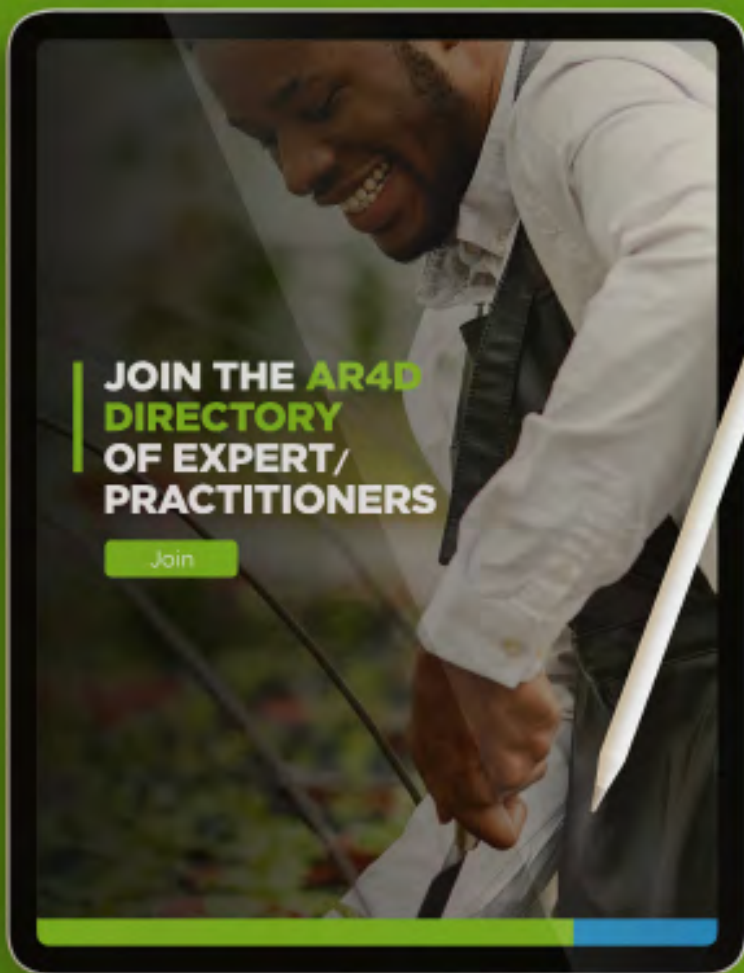
According to the various stakeholders interviewed, the roles that the agricultural equipment manufacturing sector will play in the future are mainly related to facilitating access to spare parts and maintenance services for locally manufactured equipment, manufacturing quality, high-performance agricultural equipment that is adapted to and meets the needs of end-users, promoting or encouraging the ingenuity of local craftsmen, enhancing the value of locally produced

equipment, and defining and implementing state policies to facilitate production and access conditions. Concerning the opportunities for this sector, the main ones are related to the existence of a consumer market for local agricultural machinery and spare parts, to the modernization/ facilitation of the production process and to the creation of jobs, the entrepreneurship of youth in agriculture to boost the sector, to the political will of the State to organize the agricultural equipment manufacturing sector, to the development of local skills in the design, manufacturing and maintenance of agricultural equipment and to the opportunity to benefit from an after-sales service for this local equipment. Although this sector has all these opportunities, several constraints affect its development, the main ones being the lack of financial means to access raw materials and work tools, low level of skills of actors in the production and maintenance / repair of local machinery; the problem of standardization, certification of the local manufactured equipment; weak technical, financial and promotional support; and the lack of organization of the actors. Measures were therefore proposed by stakeholders to remedy these various constraints. In addition, the influence of the various stakeholders on the success of this sector as well as their plans to help the sector in the future were highlighted in the study.

References

- Ampah, J., Ribeiro, J. X. F., Bugyei, K. A., Kumi, F., Akowuah, J. O., Ofori, H. Otchere, C. 2021. Status, Challenges and Prospects of Food Processing Equipment Fabricators in Ghana. *Scientific African*. <https://doi.org/10.1016/j.sciaf.2021.e00843>
- Balse M., Ferrier C., Girard P., Havard M., Herbel D., Larue F., 2015. Une expérience originale de mécanisation partagée en Afrique. Les Coopératives d'utilisation de matériel agricole au Bénin. Champs d'acteurs 03, FARM, Cuma France, Cuma Aquitaine, Cuma Bénin, FAO.
- Birner, R., Cohen, M. and Ilukor, J. 2010. Rebuilding Agricultural Livelihoods in Post-Conflict Situations: What Are the Governance Challenges? The Case of Northern Uganda. Washington, DC: International Food Policy and Research Institute (IFPRI).
- Birner, R., Sekher, M., 2018. The devil is in the detail: understanding the governance challenges of implementing nutrition-specific programmes on a large scale. Forthcoming In: In: Biesalski, H.K., Birner, R. (Eds.), *Strategies to Improve Nutrition Quality*, vol. 118. *World Review of Nutrition and Dietetics*, Basel, Karger, pp. 17–44.
- Binswanger, H. 1986. Agricultural mechanization: a comparative historical perspective. *The World Bank Research Observer*, 1(1), 27–56.
- CORAF 2018 Training manual of improved rice postharvest technologies. CORAF/USAID/SONGHA. Working Paper, 43p. <https://www.coraf.org/database/publication>.
- Daum, T., Adegbola, Y. P., Kamau, G., Daudu, C., Zossou, R. C., Crinot, G. F., ... & Oluwole, F. A. 2020. Perceived effects of farm tractors in four African countries, highlighted by participatory impact diagrams. *Agronomy for Sustainable Development*, 40(6), 1–19.
- Daum, T., & Birner, R. 2020. Agricultural mechanization in Africa: Myths, realities and an emerging research agenda. *Global Food Security*, 26, 100393.
- Daum, T., Birner, R. 2017. The neglected governance challenges of agricultural mechanisation in Africa—Insights from Ghana. *Food Security* 9:959–79.
- Daum, T. and Birner, R., 2017. The neglected governance challenges of agricultural mechanisation in Africa – insights from Ghana. *Food Sec.*
- De Animaw, A. T., Nkanya J. A. M., Nyakiba, J. M., Woldemariam T. H., Takeshima, H. 2016. Agricultural mechanization and south-south knowledge exchange, ESSP Research note 47.
- Dene, A 2019. Saisir les opportunités économiques de la transformation locale de l'anacarde: comment rendre la transformation plus compétitive au Sahel?, Working paper, Forum sur le Caju Sahélien, Cotonou, Benin.
- Diao, X., Takeshima, H., & Zhang, X. 2020. An evolving paradigm of agricultural mechanization development: How much can Africa learn from Asia? *Intl Food Policy Res Inst.*
- FAO 2020. Appui à l'élaboration de la stratégie nationale de mécanisation agricole du Bénin et son plan d'action. Atelier technique de validation de la Strategie Nationale de Mécanisation Agricole (SNMA), Cotonou, Benin.
- FAO 2008. Comment relever les défis auxquels sont confrontés les approvisionnement en intrants de la mécanisation agricole et le traitement des produits agricoles. Délibérations d'un atelier de travail de la FAO qui s'est tenu à Bonn, en Allemagne, lors du Congrès Mondial du Génie

- Rural, 5-6 septembre 2006. <http://www.fao.org>.
- IFDA 2008. Mission de consultation pour la réalisation d'une base de données nationale sur les fabricants d'équipement pour la transformation du manioc et la production de dérivés au Bénin. Working paper, Fonds International pour le Développement Agricole, Cotonou, Bénin.
- Fuglie, K., and Rada, N. 2013. Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa. USDA-ERS Economic Research Report, (145).
- Havard, M. and Gaudard, L. 2018 Rapport mission d'expertise scientifique du CIRAD Gestion de la mécanisation /Motorisation et Appui- Conseil, Working paper, Projet d'Appui à la Transition Agroécologique dans les Zones Cotonnières du Bénin (TAZCO), Bénin.
- Hsieh, H.F., Shannon, S.E., 2005. Three approaches to qualitative content analysis. Qual. Health Res. 15 (9), 1277-1288.
- Ilukor, J., Birner, R., Rwamigisa, P. B., & Nantima, N. 2015. The pro- vision of veterinary services: Who are the influential actors and what are the governance challenges? A case study of Uganda. Experimental Agriculture.
- Lubungu, M. and Birner, R., 2018. Using process net-map to analyse governance challenges: A case study of livestock vaccination campaigns in Zambia, Preventive Veterinary Medicine 156 (2018) 91- 101.
- MAEP, 2017. Plan Stratégique de développement du secteur agricole (PSDSA) 2025 et Plan National d'Investissement Agricoles et de Sécurité Alimentaire et Nutritionnelle PNIASAN 2017-2021. 139p
- Malabo Montpellier Panel. 2018. Mechanized: Transforming Africa's agriculture value chains. International Food Policy Research Institute (IFPRI) and Malabo Montpellier Panel. Dakar.
- Ndindeng, S. A., Manful, J., Futakuchi, K., Mapiemfu-Lamare, D., Akoa-Etoa, J. M., Tang, E. N., Bigoga J., Graham-Acquaah, S., & Moreira, J. 2015. Upgrading the quality of Africa's rice: a novel artisanal parboiling technology for rice processors in sub-Saharan Africa. Food Science & Nutrition. <http://dx.doi.org/10.1002/fsn3.242>
- PSRSA 2011. Plan Stratégique de Relance du Secteur Agricole (PSRSA). 116p. <http://extwprlegsl.fao.org/docs/pdf>.
- Raabe, K., Birner, R., Sekher, M., Gayathridevi, K. G., Shilpi, A., & Schiffer, E. 2010. How to overcome the governance challenges of implementing NREGA. IFPRI Discussion Paper 00963.
- Safdar, M. T., Terry van Gevelt, T. V. 2019. Catching up with the 'core': The nature of the agricultural machinery sector and challenges for Chinese manufacturers. Journal of Development Studies.
- Schiffer, E., & Hauck, J. 2010. Net-Map: collecting social network data and facilitating network learning through participatory influence network mapping. Field Methods, 22(3), 231-249.
- SNeA 2019. Stratégie nationale pour l'e-Agriculture au Bénin 2020-2024. <http://assets.fsnforum.fao.org>.



Are you an AR4D expert
and want to be part of
the continental pool of
Agricultural experts ?

CLICK HERE TO

REGISTER





Forum For Agricultural Research In Africa

Headquarters 12 Anmeda Street, Roman Ridge

PMB CT 173, Accra, Ghana

Tel +233 (0) 302 772823 / 779421

Fax +233 (0) 302 773676

Email info@faraafrica.org

www.faraafrica.org



ISSN: 2590-9657