



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL  
OF CURRENT RESEARCH

International Journal of Current Research  
Vol. 11, Issue, 07, pp.5121-5126, July, 2019

DOI: <https://doi.org/10.24941/ijcr.35833.07.2019>

## RESEARCH ARTICLE

### AGRICULTURAL MECHANIZATION/MOTORIZATION IN BENIN: DIFFERENT INITIATIVES, CHALLENGES AND PROSPECTIVE WITHIN THE PERIOD 1930-2016

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#### ARTICLE INFO

##### Article History:

Received 10<sup>th</sup> April, 2019  
Received in revised form  
17<sup>th</sup> May, 2019  
Accepted 06<sup>th</sup> June, 2019  
Published online 25<sup>th</sup> July, 2019

##### Key Words:

Hardness, Strategy, Financing, Cotton cultivated land, Incomes, Reforms.

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Citation: Seraphin Capo ATIDEGLA, 2019. "Agricultural mechanization/motorization in benin: different initiatives, challenges and prospective within the period 1930-2016", *International Journal of Current Research*, 11, (07), 5121-5126.

#### ABSTRACT

Many challenges determine the strategies agricultural mechanization/motorization promotion in Benin: to enter in the world tendency through development projects; to integrate the financing or/and the promotion of agricultural mechanization/motorization in the crop production activities; to be concentrated in the reduction of work hardness and the increasing of cotton cultivated lands; increase farmers' incomes and that of the State, to be equipped with consequent strategy. Thus, from 1930 to 2016, various initiatives of agricultural mechanization/motorization have been succeeded in Benin with as corollaries many challenges and perspectives. The study was to highlight those initiatives and to analyze their contributions to agricultural mechanization sector in Benin. Data collected in 2018 come from documentary review and some empirical knowledge of the item. It emerges from the study that many factors had negatively affected the adoption of agricultural mechanization/motorization as for consequence, a recurrent calling into question of each strategy. With regard to this situation, it is urging to reorganize the sector and reduce the effects of different constraints occurring from institutional reforms by prioritizing the financing of agricultural mechanization/motorization.

#### INTRODUCTION

Benin included eight (8) agro ecological zones in which are conducted diversified activities of crops, breeding, and fishing and forestry productions. Over the eleven (11) millions of hectares of available production land, little less than 60% are fitted for agriculture. The main cash crop is cotton followed by pineapple and cashew tree. The number of existing farms is estimated to over 600 000. In the majority, it is a matter of smallholder and middle holder farms directed towards many cropping systems coupled often to a small breeding. Their average area is estimated to 1.7 ha. 34% are less than one (1) hectare. Only, 5% in the South and 20% in the North of the country totalized more than 5 ha (MAEP, 2010) and the statement of cultivated lands showed that among the about 20% cultivated lands, hardly 1% was mechanized. Really, Beninese agriculture stays traditional and its development depends on the techniques of production because, the bad farming practices lead to the lands degradation (scarcity of organic matters, water and wind erosions, soils depletion). The non development of the agricultural sector potentialities depends also on the bad organization of the network and the lack of technical control of the farmers. By the time, this situation has as consequence, the rigidity of the agricultural productive system.

Generally speaking, agricultural mechanization in Africa was neglected and even dissuaded for its effect on employment creation in rural area. Today, the 2/3 of the energy devoted to land preparation for agricultural purposes in Sub-Saharan Africa find their origins in human energy. As comparison, this human energy was utilized up to 30% for the South Asian land and 25% of that of Latin America. In Africa, a big part of the agricultural energy is still manual (Lhoste *et al.*, 2010). Yet, in the countries where land is not a lack, a mechanization based only on human energy, constitutes a serious handicap to the extension of cultivated lands. Therefore, the recourse to other types of powers as animal traction or mechanical energy, when it is possible, shows often one of the target solutions (Houmy, 2008). Thus, a big margin exists of progress for animal or motorized energy utilization. Roughly speaking, agricultural production and transport in rural areas require energy of which the interested sources are triple: human energy, animal energy and the energy produced by motorized equipment; the choice among those energy sources was essentially adverbial (Starkey, 1999). According to Clarke and Bishop (2002) and FAO (2006), energies distribution among the types of agricultural mechanization in Africa, Latin America and Caribbean are (Tables 1 and 2). We agree that draft animals do until 20% of agricultural activities and in tropical Africa, only a small part of the whole work is done by tractors.

**Table 1. Energy sources for soils preparation**

Continent	Human power	Animal traction	Engine power
Sub-Saharan Africa	65	25	10
Latin America and Caribbean	25	25	50

Source: Clarke and Bishop, 2002

**Table 2. Energy sources for soils preparation**

Continent	Human power	Animal traction	Engine power
Sub-Saharan Africa	65	25	10
East Africa	40	40	20
South Africa	30	30	40
Latin America and Caribbean	25	25	50

Source: FAO, 2006

From that, mechanization has to be for Africa a necessity and not a paradox. Indeed, Africa continent has got physical conditions rather favorable to agricultural mechanization: wide areas of cultivable lands, poor topography constraints. In principle, natural obstacles to its development are not majors if it is not the vulnerability of tropical soils to mechanical works. Beyond those conditions, others constraining situations impose to Benin, the necessity of mechanization adoption. It is a matter of:

- High population growth
- High urbanization
- Important rural exodus
- Small size of cultivated plots,
- Low productivity
- Shortness of manpower
- Manual and laborious works
- Time wasting
- Low production
- Food self-sufficiency unreliable
- Low income.

## MATERIALS AND METHODS

Data collected and used come from documentary review and some from empirical knowledge of the item. Documentary review allowed the analyzing of the subject, to formulating of the problematic and the diagnosis of the situation. Finally, historical appreciation of the results and the exploitation of the empirical knowledge of agricultural mechanization/motorization in Benin enabled to catch the challenges and the future prospects which are waiting the sector.

## RESULTS AND DISCUSSION

**Different initiatives of mechanization/motorization in Benin:** Agricultural mechanization/motorization development in Benin has known different initiatives according to the following periods:

### *1930 - 1960: Animal traction*

The first trials of equipment pulled by donkey were executed from 1930 in the experimental farm of INA. The introduction itself of this form of mechanization took place around the years 1960 and was the work of the main firms of intervention in particular, the French Company of Textile and Fiber Development (FCTFD), the International Company of Rural Development (ICRD), the Switzerland Union of Cooperatives

(SUC), the Switzerland Association of Volunteers (SAV), the Bureau of Agricultural Production Development (BAPD) and the Company of Technical Assistance and Cooperation (CTAC). Those organizations carried out the total control of all the production and marketing chains and had often to promote industrial crops as the cotton in the ex-provinces of Borgou, Atacora and Zou and the palm tree in those of Atlantic, Mono and Ouémé.

### *1961-1969: Draft animals / motorization*

Switzerland Union of Cooperatives (SUC) has set up in 1961, some cooperative groupings fitted out of tractors to ensure the tillage, the harrowing and the sowing at Bembéréké, Nikki and Fombé; the rest of cropping activities were done manually. Those cooperative groupings were strongly supported by financial assistance of Switzerland. At Sékou, the Switzerland Foundation of Assistance to Technical Development (SFATD) has set up a mechanized farm intended to train the tractor drivers. The SUC wanted to associate tractors and beefs where tractors would ensure only the tillage and the beefs the maintenance works through draft animals. This practice is still used nowadays. Draft animals began in 1963 in Borgou by FCTFD at Angaradébou in the commune of Malanville, by ICRD in the region of Kandi, by SUC in the region of N'Dali, in 1965 by BAPD) in the region of Boukoumbé, and in 1966 by CTAC in the regions of Dassa-Zounmè and Savalou. This experience offered a lot of advantages because it was supported by the Volunteers of Progress and the African Company of Tobacco Intervention (ACTI). There was a very convenient control of the operations and the results. The donkeys were replaced at Dassa-Zounmè and Savalou by the beefs imported from Borgou. They undergo meadow training at Bètécoucou before to be delivered to the farmers for the real training. In 1969, the National Company of Rural Development (NCRD) has introduced the draft animals in the ex-provinces of Mono, Ouémé and Atlantic. The French Association of the Volunteers of Progress (FAVP) has intervened few years later on in Atacora and Zou. At national level in 1965, started the implementation of the Improvement Project of Draft Animals and Promotion of Rural Crafts-men (IPDAPRC) under the combined actions of Breeding Direction (BD), Agriculture Direction (AD) and Rural Engineering Direction (RED). Thus, the United Nations Organization for Food and Agriculture (FAO) with the committee of fighting against hunger has launched the draft animals' technology all over the territory with starting point, the ex-province of Borgou. The committee ensured the material purchase: plough, hoe, lifter, Canadian. With regards to the positive recorded outcomes, an important financing was launched for the period

of 1965-1971. This is the real starting point of draft animals in Benin.

### ***1970 - 1980: Intensive Development of agricultural motorization in Benin***

Beninese agricultural motorization has known a certain rise with the creation of the State farms and companies during the years 70 and 80 (the Beninese Company of Palm Tree (BCPT), the National Company of Irrigation and Hydro Agricultural Planning (NCIHAP), the National Company of Forestry Development (NCFD), the Provincial Company of Agricultural Popularization (PCAP), etc.). Then, those structures have got some important parks of agricultural equipment such as tractors, bulldozers, gyro crushers, combine harvesters, etc. for the soil preparation until the harvesting.

The State farms' creation has particularly known a craze due to the advent of revolution and the socialist option. Thus, in cooperation with the Eastern European countries of which especially Sovietic Union, Rumania, etc. the Beninese-Sovietic State farm of Massi-Lonmè, the Beninese-Rumania State Farms of Kétou and Alibori, etc. were established around the years 80. Report: With the defeats recorded at the level of the management of those equipment (weakness of labour and know-how, maintenance and training problems, etc.), the experience did not fill the expectations.

### ***1988-1990: New attempts of agricultural motorization***

New attempts of agricultural motorization were observed during the years 90. Thus, in 1988, a new experience of State farm in partnership with Argentina was set up through the Project of Agro-Pastoral State Farms of Kika (Tchaourou) and Sakabansi (Nikki) with a lot of agricultural equipment for the cropping operations from soil preparation till storage of the agricultural products. There was also, the set up of China-Africa Centre of Agricultural Machinery at the beginning of the years 90 which help to accelerate agricultural mechanization particularly the small motorization popularization through the different Centres of Rural Promotion (CRP), the irrigated sites of Dévé, Koussin-Lélé, Malanville and the Centres of Regional Action for the Rural Development (CRARD). Similarly, the Support Program to Agricultural Sector Development (SPASD) with the assistance of DANIDA has supported among other things, in the framework of the Development Project of the Systems of post-harvest, a program related to an applied research and the popularization of processing and packaging of agricultural products. Finally, the Program of Agriculture Professionalization in Benin (PAPB) started its support at the establishment of the Cooperative of Agricultural Machinery Utilization (CAMU) in the Departments of Borgou and Atacora. The major problem faced by this institution remains its poor capacity on line with its partnership "French Farmers and International Development (FFID)", capacity which allowing it to equip only two (2) CUMU per year in tractors and plows.

### ***1980 -1996: Revival of the draft animals***

It was during the years 80 that justly the Government, through the ex-CRARD, has developed in the frame of the Projects of Integrated Rural Development (PIRD), some actions in favour of draft animals. The draft animals have known a special rise since the advent of democratic revival (1990) with the dynamism of the Beninese Cooperative of Agricultural

Equipment (BCAE) at Parakou (Borgou). The BCAE manufactures some small agricultural equipment of which the full range of draft animals' equipment (plows, carts, seeders, etc.). Its ambition some years ago was to manufacture some equipment more and more moderns in processing agricultural products (hullers, shellers, roughs, squeezers, etc.). Out of the central factory of Parakou, the BCAE has set up some sections' workshops in most of county towns of the communes of Borgou, Alibori, Atacora and Donga. It is generally compounded of a forge and welding workshop in order to provide some services to the farmers utilizing draft animals equipment. At this period, more than sixty thousands (60 000) teams were set up in the North and the Centre of the country.

### ***2004-2018: Revival of agricultural motorization***

Within 2004-2005, was formulated the National Strategy of Agricultural Mechanization (NSAM) in Benin, document elaborated with the technical and financial support of FAO and adopted by the Government in 2006. The SNMA recommend among others, a reasoned mechanization which should be applied by adapting the technological choices (draft animals, light mechanization, motorization) to the ecological and social conditions of each area. Also, it is a matter of adaptation of the utilization mode of the equipment to the economical and financial situation and to the farmers, transformers and others organizations' level, by looking out to the profitability. By following this approach, Beninese Government required and obtained from some friend countries (China, India, Libya, etc.) a lot of agricultural equipment (power tillers and tractors with accompaniment implements, rice hullers, rice fan cutters, water pump and accessories, etc.). Theses equipment were set up in the Exploitation Centers of Agricultural Machinery (ECAM), in some Cooperative of Agricultural Machinery Utilization (CAMU) and in some farms of individual farmers in order to boost agricultural mechanization in Benin. At the present time, Benin has got twenty seven (27) ECMA which covered one or several communes depend on the case and they have to be the pole of agricultural mechanization promotion. This introduction of agricultural mechanization was demonstrated through a progressive and sustained passing of draft animals which has boosted the cotton production in the north regions. A diagnosis of the geographical repartition of vegetable production equipment in the different departments showed a high concentration of the draft animals equipment in the old cotton production zones of the North (Alibori: 67 710 harnesses, Borgou: 15 259 et Atacora: 9 947) and that of motorized equipment (tractors and power tillers) in some CAMU and also with some innovative farmers (Zou: 80; Atlantique: 77; Borgou: 70 and Collines: 0). In general, table 3 gives a synthesis of the introduction degree of the different types of mechanization for the main cropping operations. In vegetable cropping, it's the tillage, great energy consumer, which is the most mechanized operation. 23% of the lands are cultivated by draft animals and 1% by motorized equipment (power tillers: 12 -18 cv or tractor: 18 à 95 cv). Seeding and harvesting operations are exclusively manuals. The mechanization of agriculture engaged by Beninese Government was in line with the Strategic Program of Revival of the Agricultural Sector (SPRAS), of which the process of elaboration was launched in 2006 after the adoption of the National Strategy of Agricultural Mechanization (NSAM). Its application was expressed through the setting up of the Project for the Promotion of Agricultural Mechanization (PPAM) which benefited from the Government, two substantial

Table 3. Introduction degree of the different types of mechanization

Description	Maize %	Rice %	Cassava %	Cotton %	All speculations at national level %
Tillage					
Manual	65	84	96	49	76
Draft animals	23	4	4	38	23
Motorized	12	12	-	13	1
Transport					
By foot, by bicycle, by motor bike, by pirogue	60	81	55	3	60
By cart (DAT)	28	10	14	25	15
By pick-up, lorry and tractor	12	9	31	72	25

financial supports respectively of 10 billion in 2008 and 8 billion in 2009 in order to promote agricultural mechanization in Benin. Thus, in 2009, more than 600 tractors were acquired by PPAM for the benefit of the farmers. In this context, some important lots of agricultural equipment were acquired. Likewise, the Government has subsidized the sale's price of agricultural equipment to the farmers within the PPAM implementation during the period 2008-2014. In spite of this, a lot of farmers did not succeed to purchase them because the smallholder farmers have got limited financial resources. The Regional Union of the CAMU (RUCAMU) Borgou-Alibori counts today one hundred and five (105) members of CAMU. With technical and financial especially of Dordogne CAMU of French, the RUCAMU has decided to conduct the setting up the CAMU in the other departments (Mono-Couffo, Ouémé-Plateau, etc.) in order to reach in a brief term, a National Union of the CAMU of Benin for the best coordination of the activities and the protection of the professional interests. The diagnosis of the CAMU operating showed clearly that, despite some difficulties, those entities constituted some true implements of agricultural mechanization that needed to be strengthened, but which nevertheless, oblige admiration, for the moment, contrary to the ECMA which pained to operate as it was required.

Moreover, it is suitable to retain the creation of the Development Agency of Agricultural Mechanization (DAAM) which has taken the direction of mechanization activities following the end of the Project for the Promotion of Agricultural Mechanization (PPAM) in 2014. Also, is it necessary to underline that, during the same period, there was, the setting up of the Company "Benin Tracteurs" for agricultural machinery assembling at Ouidah in 2014. However, at the advent of the new Government in 2016, many reforms are in hand in all the vital sectors of Beninese economy. Agricultural mechanization sector does not escape from that. In this way, the Development Agency of Agricultural Mechanization (DAAM) was dissolved in the meantime of the review of the fundamental texts for the creation of a new with new orientations. Also, to show its willingness to boost agricultural mechanization/motorization development, the government revised at the decline by subsidizing the sale price of the tractor kit assembled by "Benin Tracteurs" Company at Ouidah at eight million five hundred thousand (8.500 000) F CFA instead of twenty three millions (23 000 000) F CFA as former sale price. The kit of tractor included tractor, plow, disc harrow and trailer, all for MAHINDRA brand.

**Report:** The adoption level is always stayed poor despite all the efforts supplied by the Government. Indeed, apart from few progresses in the cotton production areas, it is suitable to say that the situation did not advanced at national level and was

characterized by inaction, moreover, in certain cases by the early unavailability of the equipment which has never worked.

**N.B :** In relation to post-harvest technology, except the cotton, most of the others products benefited from motorization processing which can varying from 20 to more than 55%. Equipment from local manufacture covered the great part of the farmers' needs. Therefore, according to Sims *et al.*, (2014), agricultural mechanization can offer smallholder farmers many opportunities to improve productivity and livelihoods.

**Challenges of agricultural mechanization in Benin:** In consideration of the diagnosis, the challenges from which agriculture mechanization in Benin needs to recover from are numerous, multiple and multiform. However, without being exhaustive and less laconic, we show through the following lines, some of the most important. Thus, it is a matter of:

- Poor growth rate of mechanical cultivated areas: From 1% in years 80, no accurate number should be indicated today for lack of statistic data. At the limit, this rate could be doubled;
- Malfunctioning at institutional level of the agricultural mechanization sector;
- Smallholder farmers in Benin are still too poor to purchase modern tools;
- Poor technical control of the farmers;
- Lack of training of managers and users of agricultural equipment;
- Bad management of the equipment;
- High politicization of the sector under PPAM and DAAM;
- Limited resources of the smallholder farmers;
- Inappropriate financing of agricultural mechanization sector;
- Presence of many cemeteries of agricultural equipment everywhere in the country;
- Former experiences were not capitalized;
- Perpetual new beginning of the initiatives;
- Bad choice of the equipment either upstream or downstream;
- Many equipment of doubtful qualities and / or no suitable for the agro ecological conditions;
- Problems of land and stumps clearing;
- Lack of financial products specifically focused on investment related to agricultural machinery at lower interest rate;
- Reticence of financial market enterprises (mainly the banks) for granting credit to the poor farmers showing few guarantees ;
- Land problems: to succeed the transition of half-subsistence agriculture towards a sustainable

production system, the security of land tenure must be guaranteed by the State as well as by the laws and local traditions;

- Lack of competences in the field;
- Shortness in the extension services relative to agricultural mechanization;
- Lack of after-sales services in the importation and distribution services of agricultural machinery;
- Scarcity of maintenance and repair services in rural areas and in small towns;
- Non-existence of investments coordination in the sector;
- Lack of organization of the actors (ECMA, CAMU, Groups, individual farmers, etc.);

### Prospective

The hope is possible if the tangible experiences would be capitalized and the insufficiencies rectified through the taking into account of the challenges mentioned above. In fact, with regard to the new reforms in hand by the Government in the agricultural sector, we think that fitting solutions will be given at short or middle terms, to the different problems generated by the different initiatives.

In front of this promising panel, some of the assets to be saved are:

- The high political will;
- Existence of suitable environment for agricultural mechanization promotion;
- Possibility for financing agricultural mechanization;
- Existence of education offers in high degrees (Licence and Master) in Benin Universities;
- Increasing of farmers' income due to agricultural mechanization adoption.

Meanwhile, in order to turn upside down the tendency of not reaching the expected results (agriculture less dependent on human power), it is urging to take into account the following suggestions:

- Promote the formation of the design and executive agents, specialized in agricultural mechanization,
- Increase the affordability of modern tools compared to other modern inputs such as improved seeds or fertilizers,
- Reinforce the education system at the secondary school and at university in infrastructures and laboratories equipment with the creation of workshops of learning,
- Exempt from taxes and custom duty the agricultural equipment and all raw materials use for the manufacturing of local equipment,
- Ensure a good statement of the land tenure problem before starting with any project of land fitting up,
- Ensure the promotion of the extension function and the reinforcement of research-development in agricultural mechanization,
- Favour the emergence of credit offers at low interest rate to the smallholder farmers for purchasing agricultural machinery,

- Guide the purchasing toward new sources of agricultural equipment more suitable to Africa reality in general and to that of Benin in particular,
- Govern the purchasing of agricultural equipment by the offer of after-sales services,
- Ensure the capacity building of the existing human resources,
- Ensure the coordination of the investments in the sector,
- Organize the actors (ECMA, CAMU, Groups, individual farmers, etc.) of the sector of agricultural mechanization,
- Promote and develop public-private partnership;
- Promote an conservation and intelligent agriculture face to the climate: the necessity to adopt a sustainable mechanization and respectful of environment;
- Depoliticize the management of the sector of agricultural mechanization;
- Create a new institutional structure for the management of agricultural mechanization in Benin.

### Conclusion

The main challenges for the emergence of flourishing and competitive economy in Benin pass among other things, by the modernization of the agricultural sector. That was especially appropriate as the agriculture sill remains for a long time in Benin, the staple reservoir for wealth production. However, the agricultural sector can play efficiently this role if certain conditions are satisfied, like increases in farm size which is the key to expanded use of mechanization and water control. The tangible acquired is the motorization adoption even Benin is still at the early stage of agricultural mechanization. Indeed, it involves some structural changes in the Beninese agricultural farm households: growth of the cultivated areas, increasing of the work productivity, some changes in agricultural practices and the organization of the operating system. The CAMU experience is a very good illustration.

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