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Research

Trends and perspectives of mechanization and agricultural machinery in Mexico for the 21st century

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Abstract

Agricultural productivity can only be increased today using advanced technology, in Mexico a forgotten technology for various reasons that go beyond the purpose of this work, is mechanical technology, i.e. agricultural mechanization, is a crucial input for agricultural production and one that has historically been neglected within the context of developing countries. Factors that reduce the availability of agricultural energy compromise the ability to grow enough land and have long been recognized as a source of poverty. By increasing the supply of energy to agriculture, more tasks can be done at the right time and larger areas can be grown to produce larger quantities of crops and conserve natural resources. Several authors conclude that agricultural mechanization is necessary to increase the productivity of crops, among others. For this reason present the trends and perspectives of agricultural mechanization in Mexico for the 21st century, the former being necessary for national agriculture to emerge from the lethargy it has been in during the last century, which has led the country to a state of food in security, which has been hidden by government agencies for years. It presents a great opportunity to detonate the agricultural and industrial sector by taking advantage of the conditions of lack of equipment and agricultural machinery for all agricultural processes, since the design and national manufacture of these goods would turn the country into an agricultural and industrial power, increasing employment and development of both sectors and reduce poverty.

KeyWords: Agriculture Tractorization; Harvester: Planter.

Introduction

Agriculture in Mexico is currently a complex productive system, from small plots that cannot even be self-sufficient, due to multiple problems such as competition from imports of lower-priced agricultural products, lack of technology, among others, to large properties with use of high technology mainly exporters, going through a range of properties with different

qualities of use of intermediate technologies, having the challenge of food security, although in the country is currently deteriorating due to large imports of basic products. In the national context, Mexico addresses some of these indicators - albeit in a dispersed manner - which prevents achieving a real impact in the agricultural sector. In the agri-food sector, it is a common initiative to increase the yield of crops by making production processes more efficient, applying inputs such as water, fertilizers and pest control; favoring prevention and not correction [1].

Agricultural productivity can only be increased today using advanced technology, in Mexico a forgotten technology for various reasons that go beyond the purpose of this work, is mechanical technology, i.e. agricultural mechanization.

Mechanization is a crucial input for agricultural production and one that has historically been neglected within the context of developing countries. Factors that reduce the availability of agricultural energy compromise the ability to grow enough land and have long been recognized as a source of poverty. By increasing the supply of energy to agriculture, more tasks can be done at the right time and larger areas can be grown to produce larger quantities of crops and conserve natural resources. The application of new environmentally friendly technologies allows farmers to produce crops more efficiently using less energy. Sustainable agricultural mechanization can also contribute significantly to the development of value chains and food systems, since it has the potential to make activities and functions of postharvest, processing and commercialization are more efficient, effective and friendly to the environment [2].

Several authors conclude that agricultural mechanization is necessary to increase the productivity of crops, among others [3,4,5,6,7,8,9,10] for this reason present the trends and perspectives of agricultural mechanization in Mexico for the 21st century, the former being necessary for national agriculture to emerge from the lethargy it has been in during the last century, which has led the country to a state of food insecurity , which has been hidden by government agencies for years.

Materials and Methods

The information sources for data collection were mainly the Eighth National Agricultural Census conducted by the National Institute of Statistics, Geography and Informatics (INEGI), and FAO estimates. To collect information searches on agricultural mechanization in the country were made in printed data bases and the Internet, of importers and distributors, scientific journals, professional thesis, newspaper articles, etc.

Mechanization and Agricultural Machinery in Mexico

Agricultural Mechanization

Definition: The agricultural mechanization is an instrument of management of agriculture. The change of level or type of mechanization or industrialization will produce an increase in crop yields, only if it is used by the producers to eliminate or reduce the specific limitations, in order to achieve the production potential of their resources. However, production is determined by many individual elements and by the way they interact. Mechanization is only one element of the set of inputs that determine production and generally, it is not possible to isolate the effect on said production and define it in quantitative terms. Mechanization is a development process that must be determined, mobilized, assigned and supported according to technical, economic, social, and political conditions and in line with national development objectives. Mechanization is part of the strategy to achieve development objectives and should not be confused with a national development policy [11].

In the country there are not many jobs on mechanization and agricultural machinery in Mexico only those of [12,8,13,14,15,16,17,18] although there have been mostly regional works in the state of Mexico [19,16,20,21,22,23,24,25] this situation being the main obstacle to agricultural mechanization in the country: centralization in the area of influence of agricultural research institutions located in Texcoco, Mexico.

Tractorization

From the study carried out by [15] on the tractor park in Mexico, it is concluded: the obsolete tractors per year are 14 905. The demand for tractor hours per year is 780 562 191.5

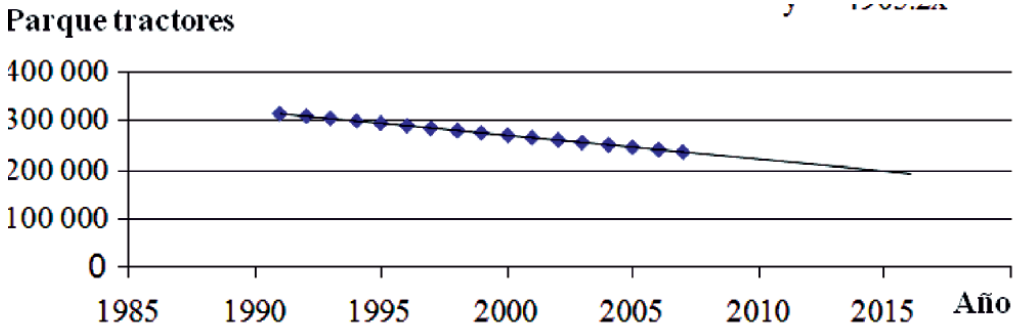

Figure 1: Stocks and linear trend of the Mexican tractor park 1991-2007. FAO Stats (2012).

Then considering an annual use of 1 000 hours the demand for tractors is 780 562. The estimated park for 2011 is 223 526. Thus, the deficit of tractors is 557 036 units. The current park tends to decrease in 4 905 tractors per year, despite the contributions, to continue this way by 2015 will have decreased by 100 000 tractors for what needs to be taken, so that the following measures would improve the tractor park in Mexico

- Increase in the tractor park by around 20,000 units per year because only those that are obsolete are 15,000 so that there is a real increase since the trend is now the constant decrease of this, projecting a smaller amount to the 200,000 tractors for 2015.
- Introduction of two wheels tractors and small tractors appropriate to the size of agricultural property, to increase the productivity of these, it would be ideal that the used vehicles were of design and national production, although in principle it will start with import units.
- Incentives for the manufacture of tractors and two wheel tractors of national technology, because this would cheapen the investments to increase the park of tractors and develop the industry of capital goods.
- Incentives for the introduction and manufacture of attachment systems of implements to pick-up vehicles.

Mexico is a major exporter of tractors in the segment of medium power and a leader in the automotive industry, but the country has high levels of poverty with low productivity in agriculture. Mexico can be a leader in the manufacture of tractors in the segments of low power, harvesters and power tillers, if the manufacturing industry of these goods is not treated as a sector, rather is integrated into the auto sector. Mexico can reduce rural poverty by increasing productivity, by availability of low power tractors, tractor powered

combines and power tillers at affordable prices [26] urgent measures in this regard.

Harvesters

In the systems of agricultural production the crop is the last operation that is carried out in the field, being this carried out of form by-hand ,by hand-mechanical and mechanical ,en this last one self-propelled teams they are used for the gathering of grains (cereals and oleaginous), cotton, cane of sugar, etc. For the crop of grains (corn, sunflower, wheat, etc.), specially designed bolsters are coupled (corn, sunflower, stripper), while it stops cotton and cane of sugar, teams are used with characteristic specific.The combine harvester, or simply combine, is a machine that harvests grain crops. The name derives from the fact that it combines three separate operations, reaping, threshing, and winnowing, into a single process. Among the crops harvested with a combine are wheat, oats, rye, barley, corn (maize), soybeans and flax (linseed). Combine harvesters are one of the most economically important labor saving inventions, significantly reducing the fraction of the population that must be engaged in agriculture. [27].This highlights the importance of the combine for the success of agriculture and complexity involved for both its operation and its design and development. [28]. Being so is had few studies they are carried out on the park of harvesters in the world agriculture due to the previously exposed thing that is given priority to the study of the park of tractors, and in Mexico it is null the work in this sense. Mexico is from the close of AC Mexican factory in San Luis Potosi, in the late nineties net importer, since the distribution of transnational John Deere, Agco, CNH and Claas import them from other factories in others countries. And in 2007 Mexico imported harvesters for 102 million US dollars which US 76.6%, 7.6 in Germany, 5.8 in Brazil, and 10% other. John Deere being the leader in the Mexican market for combines [16].

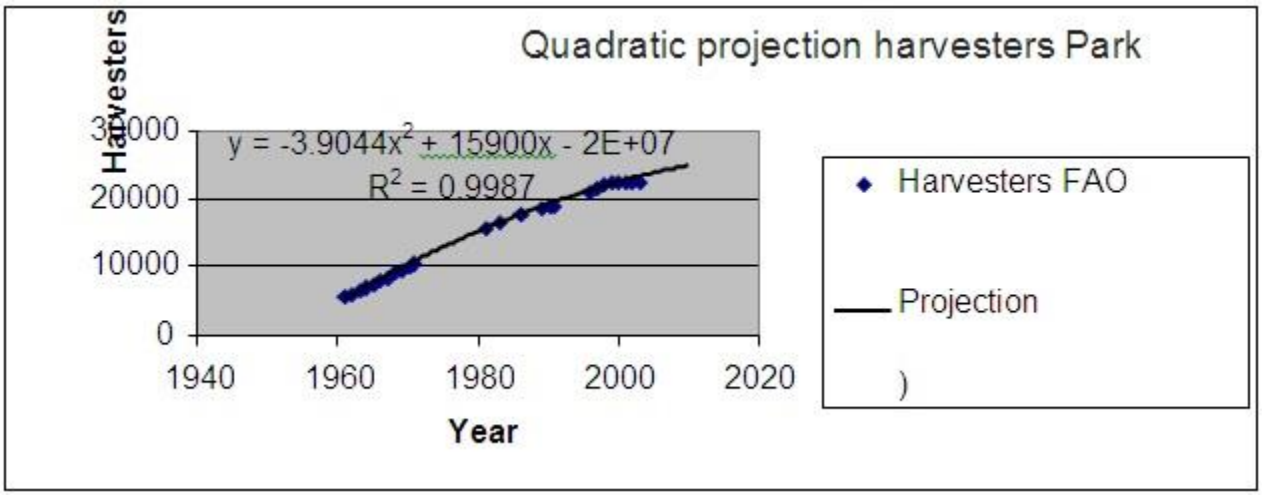

Figure 2: Quadratic projection Park harvesters in Mexico according to FAO dates

In Mexico they have not made efforts to design and develop a national technology harvester, only exists the effort made by Shinichi Kondo for design rice harvester [29], others works are [30]. Designing a system for a combine threshing of grain Stripper type driven by the tractor [31] Design of a combing cylinder for a stripper type grain harvester, powered by tractor. Other works have been directed towards the design of a bean harvester [32, 33, 34, 35, 36]. México is from the closing of

Allis Chalmers-Mexican factory net importer for importing combines in 2007 the amount of 102 million US Dollars of which the 76.6% OF United States, 7.6% in Germany, 5.8% in Brazil and 10% from other countries. The market for harvesters in Mexico is between 1000-1500 harvesting year.Being the market leader John Deere.The approximate cost of a secondhand harvester JD 9500 -120 000 US $ because the price of a new harvester is in around 400 000 US $, in the country most farmers can only buy second hand harvesters for a new price is too high, and the country can no longer rely machines used to harvest their crops. In India are used "Tractor-mounted" or "tractor-driven" combine, the combine is compact, making it suitable for farm fields that typically range in size from just 0.5 to 10 acres, and they are more economical than self-propelled harvester [37].The cost is 15 000 to 20 000 US $ without tractor and $46,000 to $48,000 in U.S. dollars included tractor. There is a high potential for these machines in Mexico since small properties are dominant in the country. The companies combines manufacturers must take the opportunity manufacturing in Mexico (self-propelled or tractor driven) Combines, because there customers and do not exist factories providing the potential market and that the country has a global industry leader in auto parts manufacturing in addition to the free trader export help.That being that the following measures would improve the park that combines in Mexico

- Increased park-harvesters at around 20,000 units per year for only the remaining obsolete are 15000 so that there is a real increase 2. Introduction of suitable combines the size of agricultural property 3. Incentives for the development of national technology combines, as this would lower the investment to increase the park and develop the capital goods industry.

Planters

México imports 14 million pesos in seeders of which 53% is from the United States, 16.6% from France, 11.4 from Italy, 8.7 from Brazil, 5.5% from Spain and 4.7% from others countries. Donoso 2007. It is estimated that there is a market of Seeders of about 3,000 machines/year. About 1800 imported and another 1200 of national manufacture, of them 500 of Direct sowing approximately. Predominates the need for planter of coarse grain - conventional - and direct seeding of fine and coarse grain with fertilization. In Mexico, the production of seeders is mainly oriented to the domestic market, but sporadically they are exported. As in other markets, the segment of planters and agricultural implements has more local characteristics, with medium-sized manufacturers that also export and import [38].

Planters	Imports	Exports
2008	5541	96039
2007	15328	89262
2006	4718	119407
2005	4966	130412
2004	4030	72575

2003	2271	35974
2002	2296	
2001	82206	
2000	47993	

Table 1: Imports, exports of planters from 2000 to 2008. Own elaboration with data from FAOstat.

Manufacture in the country- This is done without the participation of large brands, which is why Mexico should take advantage of this situation and develop the agricultural machinery industry in this sector, and strongly support the industries that are engaged in this, such as local manufacturers Of seeders that are 5 in the area of Bajío or center of the country, in addition to others in other regions of the country, among them produce about 1500 seeders of which a good amount are for Direct seeding. The seeders that produce are all of 3 points, those of coarse grain with mechanical distributor and pneumatic of national origin. They are of 2 and 4 furrows to 80 cm with robust construction, with distributor of fertilizer to the broadcast and located. The fine-grained ones are crawling. The design technology is rudimentary, but the product is adapted to the conditions of production of the Bajío and to the idiosyncrasy of the local producer [39].

Research on seeders

Also there are investigations in seeders made by different authors and institutions; in the Antonio Narro Agrarian Autonomous University has given impetus to research in the evaluation system of metering precision seed allows monitoring the quality and efficiency of metering mechanisms for service industry agricultural machinery as well as facilitate the teaching and research systems varying doses of seeds, planting prescriptions changes [40].

Autonomous Chapingo University	Torres 2015	Intelligent Seed and Fertilizer Dosing System in Seeders-Fertilizers
Autonomous Chapingo University	Perez 2015.	Design of an air-assisted direct seed drill
Autonomous Chapingo University	Rosales 2015.	Design of a wheat planter coupled to a two wheels tractor
Autonomous Chapingo University	Lopez 2014 Fernandez 2013	Development and evaluation of a multi-purpose seeder operated by a two-wheeled tractor
Autonomous Chapingo University	Fernandez 2013	Design of a stationary planter of garlic cloves (Allium sativum) with apex orientation
Autonomous Chapingo University	Flores 2009	Design of a mycorrhizal doser coupled to a mechanical seed drill
Autonomous Chapingo University	Mendieta 2009.	Corn seed metering mechanism or fertilizer for versatile sowing

Autonomous Chapingo University	García 2008.	Design of a pneumatic seed metering mechanism for double-row grain planting
Autonomous Chapingo University	Sanvicente , Merino 2004	Design of a fertilizer planter, pesticide applicator for conservation tillage
Autonomous Chapingo University	Martínez 2003	Design of a sowing machine associated with animal traction (maize and bean)
Autonomous Chapingo University	Balderas, 1995.	Design of a small-grain planter for the multi-plow
Autonomous Chapingo University	Salazar 1995.	Design of a bean planter (Phaseolus vulgaris L.)
Autonomous Chapingo University	Ramírez,1994.	Design of a lentil planter for animal traction
Autonomous Chapingo University	Martínez,1993.	Design of a unit seed drill
A.Agrarian Antonio Narro University	Reynolds 2006	Design of an intelligent pneumatic seed dosing system
A.Agrarian Antonio Narro University	Segundo2004	Design of an Intelligent Seed Dosing System, Based on the Use of Microcontrollers (Phase 1: Evaluation of Neumatic Dosifiers).
A.Agrarian Antonio Narro University	Santos 1993	Design, Construction and Evaluation of a Manually Arranged Vegetable Seeder
A.Agrarian Antonio Narro University	Arellanes 2006	Redesign of a planter coupled to a two-wheeled tractor for walnut
University of Guanajuato	Prieto 2015	Design of a seed drill for granulated material
University of Guanajuato	Chavez 2007	Design of the drive system of a precision pneumatic seed drill for garlic
University of Guanajuato	Ferreyra 2001	Design and construction of an amaranth planter coupled to an agricultural tractor
University of Guanajuato	Gomez 1998.	Design, construction and testing of a prototype animal draft planter for intercropping
University of Guanajuato	Marquez 1997	Construction of a lentil planter for animal traction
University of Guanajuato	Venegas 1987	Adapting a seed drill to a high clearance two wheels tractor
University of	Palafox 1987.	Design of a seeder for the tractor SIDENA 310

Guanajuato		
UNAM	Torrez 2000	Design and construction of a portable maize seed drill
UNAM	Olivera 1982	Design, construction and testing of a seed drill
UNAM	Toro . 1986	Design of a garlic planter

Table 2: Bachelor's and master's thesis developed at Autonomous Agrarian Antonio Narro University, UNAM, Autonomous Chapingo University and University of Guanajuato adapted from [38].

In order to carry out the above, it will be necessary to have new technology and capital goods such as agricultural machinery, the persistence of the capital goods industry as a vector of diffusion of technical progress is the primary reason to promote it, for which we must establish strategies as are the manufacturers of Argentine planters to advance in the competitive globalized world today, in our case CIMMYT can coordinate the domestic manufacturers to strengthen in the Mexican market, As well as to make alliances with the Argentine manufacturers that are leaders in direct sowing at international level, in manufacturing of harvesters they have the experience of a century at the same time that the transnational companies, and in tractors they have the impetus of realizing alliances to remake its National manufacturing industry of tractors, since they have been together with Brazil in Latin America those who have had a local industry of manufacturing of tractors, at present Pauny and Agrinar make them in Argentina, later the same can be done for the other goods of capital in agriculture such as plows, harrows, sprays and other agricultural implements.

Mexico in the segment of planters unlike the segments of tractors and combine harvesters, in which in the first only meet manufacturers and in the second it does not even exist in the country, has a national industry of manufacturing of planters strongly rooted in the country with its own technology. This situation was evidenced by not allowing the emergence of Argentine planters, as well as infrastructure to continue the research and development of new designs of seeders in the four agricultural institutions. It must be invested in Precision Agriculture technology with seeders with intelligent metering so as not to be left behind this industry. If this condition is put into practice the economic outlook is very encouraging for this segment of the national agricultural machinery industry.

Conclusions

It presents a great opportunity to detonate the agricultural and industrial sector by taking advantage of the conditions of lack of equipment and agricultural machinery for all agricultural processes, since the design and national manufacture of these goods would turn the country into an agricultural and industrial power, increasing employment and development of both sectors and reduce poverty.

References

1. Flores V.J. (2016) Agricultural Perspectives: Facing new challenges with greater investment.
2. Sims BG, J. Kienzle (2006) Farm power and mechanization for small farms in sub-Saharan Africa FAO. Rome.
3. Soto, S. M. (1983) Introduction to the Study of Agricultural Machinery, Mexico, Edit. Threshing.
4. Binswanger, P. H. Danovan G. (1988) Agricultural Mechanization; Problems and Options, Washington D. C, World Bank.

5. Cadena, Z. M (1997) Situation of agricultural mechanization in Mexico, In: Agricultural Machinery, Anthology, DGETA, Mexico.
6. Mialhe, L. G. (1996) Agricultural Machinery Tests & Certification, Piracicaba, S.P. Brazil, Ed. Fundaçao de Estudos Agrarios Luis de Quiroz, S.P. Brazil.
7. Cadena, Z. M (1997) Situation of agricultural mechanization in Mexico, In: Agricultural Machinery, Anthology, DGETA, Mexico.
8. Negrete J. C. (2006) Agricultural Mechanization in Mexico.
9. Ortiz M.G (2016) Agricultural mechanization. Mexican council of social sciences 5th National Congress of Social Sciences "The emerging agenda of the social sciences: Knowledge, criticism and intervention".
10. Shkiliova L, Fundora P.R, Jarre C (2014) AGRICULTURE The role of mechanization in the sustainable intensification of agricultural production (ISPA) 32-43.
11. Cortés M, Elkin, Álvarez M, Fernando, González S et al. (2009) Agricultural Mechanization: Management, Selection and Administration of Machinery for Field Operations. CES Journal Veterinary Medicine and Zootechnics.
12. Lara L.A. (2000) Trends and Requeriments of Mechanization: The case of México. Proceedings of the 1st Latin-American Meeting of the Club of Bologna, Fortaleza (Brazil), 20-31.
13. Negrete J.C (2011) Agricultural mechanization policies in Mexico. Iberoamerican Journal of Science, Technology and Society 1-22.
14. Negrete J.C, Tavares, M.A.L Tavares, M.R.L (2012) "Design of agricultural tractors in Mexico", Revista Ciencias Técnicas Agropecuarias 21:5-11.
15. Negrete, J.C. Antonio Lilles Tavares Machado, and Roberto Lilles Tavares Machado (2013) Agricultural tractors park in Mexico: estimation and projection of demand. Revista Ciencias Técnicas Agropecuarias.
16. Negrete, Jaime Cuauhtémoc (2014) Rural Poverty and Agricultural Mechanisation Policies in Mexico.Journal of Agriculture and Environmental Sciences 3:45-66.
17. Duran-Garcia, H.M Romero-Mendez R (2007) Status of agricultural production and mecha-nization in Mexico. Journal of Food, Agriculture and Environmental 5:216–219.
18. Lescieur L.S. (2017) Agricultural Mechanization in Mexico. University Antonio Narro. Buena vista, Coahuila. Mexico.
19. Ochoa B. J. G. (2010). Study of the Farm machinery park in the State of Mexico. SAGARPA, INIFAP, CENEMA, Federal Government.
20. Ayala G A.V, Audelo Benítez M.A, Aragón Ramírez A (2011) The situation of the tractor market in Mexico, perspectives and challenges in Certification.Textual 58: 91-111.
21. Ayala G.A. V. Gonzalez G. M, Limon O. A (2016) Mechanization of the corn and amaranth production process in the central region of Mexico. Rev Cie Téc Agr 25: 4.
22. Larque S. B. S (2012) Analysis of agricultural mechanization of the Atlacomulco region, State of Mexico. Rev. Mex. Science Agrí 3: 4.
23. Ayala G.A. V, Gonzalez G. M, Limon O. A (2016) Mechanization of the corn and amaranth production process in the central region of Mexico. Rev Cie Téc Agr 25:16
24. Montoya E.I (2018) Agricultural Mechanization Level Study: Case Municipality of Almoloya de

Juarez, State of Mexico. Autonomous University of the State of Mexico. Toluca, State of Mexico.

25. Garduño M.M.I, Gutierrez A.E.G (2018) "Comparative State of the Level of Agricultural Mechanization between the Municipalities of Toluca and Metepec, State of Mexico" Universidad Autónoma of the State of México.Toluca, Edo de Mexico.
26. Negrete J.C.R (2015) Integration of tractor and combines industry with automotive industry as a strategy to reduce rural poverty in Mexico. Journal of Hill Agriculture 6:1.
27. Quick R.G, Buchele W. (1978) The big Harvesters .American Society of Agricultural Engineers.
28. Moraes, Manoel Luiz Brenner de (1999) Grain harvesting and processing machines. Pelotas: University - UFPel.
29. Hernandez A.L, Kondo Shinichi (1993) Modernización de la tecnología de producción de arroz para los productores de pequeña escala en la zona central de México. Centro Investigacion Regional del Centro. Zacatepec, Mexico.
30. Ochoa B.J.G (2000) Design of a combing cylinder for a stripper type grain harvester, tractor powered.
31. Perez M.M (1999) Design of a threshing system for a combine grain Stripper type driven by the tractor.
32. Sosa Cruz, J. (1999) Designing a bean harvester.Revista Chapingo. Serie ingeniería agropecuaria, México 2:87-92.
33. Robles C.J.F. (1997) Designing a bean harvester.
34. Corona C.J, Trucios C.G.C (1994) Design and construction of a cutting member to rows bean.
35. Villaseñor P. C. A. (2000) Designing a bean harvester.
36. Enzástiga J (1997) Recolector de frijol.
37. Fisher M (2012) A combine harvester made for India's small farms.
38. Negrete J.C. (2017) Economic prospects and current situation of the planter manufacturing industry in Mexico.
39. Bragachini M. (2011) Report of the trip to Mexico
40. Campos M.S.G, Cadena Z.M, Ramirez F.G (2014) Development of Equipment, Sensors and Instruments for Precision Agriculture and Conservation Tillage. Dept. of Agricultural Machinery. UAAAN Mexico.