

Research article

Strategies for Technology Transfer of Agricultural Mechanization in Mexico

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Abstract

In Mexico, the technology transfer of agricultural mechanization process has been hampered for several reasons, due to which subsistence agriculture dependent on animal traction and human strength. Despite the introduction of machinery is imported and in some cases assembled at home with a percentage of domestic components adoption has been exploited only in large agricultural enterprises and medium-sized farmers engaged in commercial agriculture. The objective is to analyze the relationship between the strategy of transferring technology and agricultural mechanization development planning in Mexico. Final Strategy: It should remove the restrictions already mentioned to mechanization in the country 1.- Implement State Performance in the executive and legislative levels and provide a legal framework to base and continue the policies of mechanization. 2.- Ending the debate in academic circles about agricultural mechanization 3.- Encourage the production of iron and promote the skills necessary for the manufacture of tools and equipment such as casting, welding and machine tool management in rural areas. 4.- Promote access to machines and equipment appropriate to the size of most farms in the country, and the demand for such machinery and 5.- Analyze current local alternatives to strictly domestic manufacture of

agricultural machinery.6.-Implementing a system like the incentive program similar to the mechanization of Brazil called PRONAF (Programme for Strengthening Family Agriculture), which provides credit for the purchase of agricultural machinery with low interest rates, farmers called "family", which are small farmers. 7.-Integration of industry assembly tractor and combines a dynamic growth of the automotive industry in Mexico.

Keywords: Agricultural Mechanization ,Technological transfer, Strategies ,México,Mexican Agriculture.

Introduction

In Mexico, the technology transfer of agricultural mechanization process has been hampered for several reasons, due to which subsistence agriculture dependent on animal traction and human strength. Despite the introduction of machinery is imported and in some cases assembled at home with a percentage of domestic components adoption has been exploited only in large agricultural enterprises and medium-sized farmers engaged in commercial agriculture. Mexico is a developing country whose main source of income was agriculture, due to the fact that priority was given to industry and services, for this again the importance it had; agricultural mechanization played a vital role, it is therefore necessary that appropriate strategies are implemented. Today the Mexican countryside in a difficult situation due to many factors (lack of productivity, capitalization, natural disasters such as floods and droughts, lack of sound policies, etc.). Generated far as poverty, migration and lack of supply food recourse being had to import these. Since then the only option for increasing agricultural production is to increase productivity, and this can only be achieved using mechanization at all levels. Under these considerations, agricultural mechanization is part of the strategy to achieve the objectives of agricultural development in different phases including design, manufacturing, distribution and operation of all types of tools, implements, machinery and equipment for the use of agricultural land; This adds to the stages of production, harvesting, processing and transformation of raw materials. You need to consider that most of the small and medium farmers do not have, or are economically able to buy own equipment for work preparation, planting, crop maintenance and harvest their products therefore cannot increase their production and productivity to be competitive. Anonymous 2001 .

Any effort that seeks to increase agricultural production without taking into account an appropriate machining strategy, never have positive results. In our countries (under development), generally, planners and politicians do not understand the dimension of agricultural mechanization as a development tool, so do not make policies and strategies for promotion .Bolaños 2000.

It is no stranger to the development and progress of an agricultural region or country, heavily dependent on human and animal power capacity or motor which provides per unit area; then justifying the provision and proper use of agricultural machinery, as essential to the production process is effective and that the growth of the agricultural sector plays a key role in reducing poverty and social inequality condition. Negrete 2014.

A national strategy for agricultural mechanization reflect those definitions and will serve as project basis and hold that the contribution of mechanization in the development process. It is important to understand that the strategy is not the same as politics. The policy establishes the parameters within which development programs are run. The strategy determines which resources are available for development programs and how to identify, mobilize, deploy and sustain these resources for the execution of those programs. Gifford .1993.

The objective is to analyze the relationship between the strategy of transferring technology and agricultural mechanization development planning in Mexico, and is focused on those who perform to the above was performed research using practical methods of reviewing documentation study experiences in similar studies in other developing countries. The purpose of an agricultural mechanization strategy is the creation of an institutional policy and market in which farmers and other agricultural machinery users have access to this, according to their economic capacity and technical needs. There should be options of hand tools, animal traction and mechanical drive with due support service, repair and maintenance. The strategy should cover the import and local manufacture of tools, equipment and machinery, repair and maintenance, training and outreach programs, improving traction animals in animal health and breeding. Promoting systems and to finance the acquisition of animals traction and machinery. Policies are set by the government to achieve specific objectives. The strategies define the way in which policies are and will be implemented with emphasis towards market liberalization and the recognition that the private sector is more important for economic development actor, formulating an agricultural mechanization strategy emphasizes the creation conditions conducive to the adoption of appropriate agricultural tools, implements and machinery in the most effective and efficient way, the strategy consists of policies and institutional reforms and recommendations, but also includes specific programs and projects. The strategy should be dynamic, and will need to be continually refined, revised and adjusted. Rijk .2012.

The formulation of an agricultural mechanization strategy consists of several logical steps:

. The logical first step will be the analysis of the national situation of agricultural mechanization , this includes the national inventory, domestic manufacture of agricultural machinery, import and description of existing agricultural systems.

Step identify policies that impact and to analyze the problems and constraints.

Third step before formulating the strategy is important to define the future situation ideal. The resulting strategy should be to define the actions required to move from the current situation to the future situation .

Finally, the strategy document clearly outlines the actions and activities, which will assist policymakers and planners to implement the strategy. Clark 2000 .

The lack of well-defined strategies on agricultural mechanization is a major constraint to increase agricultural production and efficiency. Gifford 1993.

As a key element of the overall development, agricultural mechanization is not getting enough attention from development planners and government policy makers. Overall mechanization component in national development plans for agriculture and the rural sector is weak or absent in most developing countries, development planners tend to not fully appreciate mechanization. There are some specific policies dealing with mechanization and their complex relationships with other technical, economic, social and political factors in development.

While development planning has evolved generally gradually from that level, planning of agricultural mechanization in most developing countries, has made little progress beyond the stage of project list. The potential dangers of this situation were reported by Shaw 1970 , cited by Gifford 1993.

"mechanization is important to define the future of agriculture in developing countries, their governments should give top priority to developing coherent national strategies that address the full range of issues that arise."

The problems have been mostly in the political apathy of national and international aid agencies

Rasouli, 2009 ,performed a study to determine the main causes that affect the implementation of a national program for agricultural mechanization in Iran, used the Delphi technique, which is to submit questionnaires to experts on a particular topic in this case were carried out three rounds which are described below.

Round the top three spots were

1.-Properties and small farmers scattered 2.-Lack of a national strategy for mechanization 3.-Lack of common understanding of what comprises the mechanization

second round

1.-Lack of common understanding of what comprises the mechanization 2.-Lack of a national strategy for mechanization 3.-Lack of support from manufacturers and distributors

round Three

1.-Properties and small farmers scattered 2.-Lack of common understanding of what comprises the mechanization
3.-Lack of a national strategy for mechanization

Summarizing the experts agreed the three rounds of the study that the lack of a national strategy of mechanization is one of the top three causes that affect the implementation of agricultural mechanization.

In the Philippines in a study the results showed that the most important challenges for agricultural mechanization were: lack of information, limited resource farmers, small size of farms, lack of proper equipment, lack of experts in mechanization, political interference and institutional weaknesses, and concludes that the strategies to follow is to remove these barriers. Paras Jr. 2005 .

Steps in formulation of agricultural mechanization strategy Bishop.1997 .

1.-Analysis of the present situation

a.-economic environment b -.politicalenvironment c.-agriculture farming systems d.-agricultural machinery industry e.-Institutions

2.-Future Scenarios

a.-development of the national economy, b.-implications for agriculture c.-farming systems development d.-power requirements and equipment e.-implications for agricultural machinery industry

. 3 - The strategy

a.-structure role of government and the private sector b.-policy and institutional recommendations c.-programs and projects

Method

To implement the strategy the various recommendations of the experts mentioned in the literature review followed.

There are two important situations that resolve on mechanization to implement a strategy;

1.-Total energy demand based on increasing agricultural production

2.-To achieve this is to decide on the right combination of technology manual, mechanical and animal power for each specific situation.

This should solve the objectives of providing food self-sufficiency and improvement of life of a growing population, this strategy should also address the following questions

1 - what type and level of mechanization which must be promoted

2.-which should be the role of the public sector

3.-which should be the role of the private sector

4.-As should be invested in the development of sustainable mechanization in the country

STEPS STRATEGY

1.-analyze the situation of agricultural mechanization and prepare and make the diagnosis 2.-define actions to move from the current situation to the desired future situation that is preparing the strategy and action plan 3.-organize the implementation and follow

Summarizing analyze the demand and supply to make decisions accordingly

Analysis of the national situation of agricultural mechanization, this includes the national inventory, domestic manufacture of agricultural machinery, import and description of existing agricultural systems.

Results and Discussion

NATIONAL INVENTORY and ESTIMATION OF TRACTORS

Technological decline in agriculture in Mexico is notable as Cadena 1997, reported that there was a power deficit of 4'140, 557.6 kW (5'553, 323 Hp), ie, 79.333 units of tractors 52.19 kW (70 Hp) and same reports that the industry had a capacity to produce up to 19,000 units a year, adding 10,000 to 9,000 that occurred, I think that would cover the deficit in 8 years of 79.333 tractors, but for 2012, Negrete 2013 found that the deficit is 557.036 tractors.

TRACTOR SALES IN MEXICO

Tractor sales are also an indicator of the performance of investment in the agricultural sector. In the last thirteen years, annual sales, on average, have fallen from 9.532 to 3.552 units. This drop in sales probably would have been even greater if it had not implemented the program "Mechanization" from 1995 and as part of the "Alliance for the Countryside", by which the federal government has awarded a producer subsidy equivalent to 20% of the list price of tractors (state governments also provide support that varies from state to state). Salcedo 1999.

That being currently match CIIDRI the Mexican market was very stable and had average sales of 10,000 to 11,000 tractors per year since 1997 with a cost per tractor ranging from 16,000 to 60,000 U.S. dollars. Potential market in 2004 ranged from 15,000 to 18,000 units but the sale was 11,000, which clearly represent a deficit of total production companies currently engaged in the manufacture of tractors are producing below capacity 90-85%, Jimenez 2008.

MAIN CROPS IN MEXICO

The area of work in Mexico is 31.2 million hectares, where 29.9 are agricultural, 1.3 are natural, rangeland and pastures were sown once in 5 years

There are 5.5 million units of production and agricultural land in 2007 was 30.2 million hectares. of which 13.9 are annual crops, perennial crops 8.8, where 7.5 million of you were not planted. INEGI 2007.

REQUESTS FOR TRACTORS AND EQUIPMENT ACCORDING TO THE TOTAL ACREAGE.

Negrete found for 2012 demand for tractors. Than 780.562 tractors

REQUESTS TO THE SIZE OF THE AVERAGE PROPERTY IN THE COUNTRY.

In our country according to the Masera 1990, surface for the acquisition cost of a medium tractor is at least 25 hectares. This fact is corroborated by Lara Lopez 1979, who in a study found that the equilibrium point for a typical tractor assembly in Mexico Category II totally dedicated to machine contractors Agricultural work breakeven is 31 hectares. And unfortunately in Mexico agricultural properties have average size of small size which are mentioned below, less than 2 hectares, 29.5% between 2 and 5 have 24.2%, more than 5 hectares 36.1%. This indicates that the owners of 2 hectares and with between 2 and 5 hectares totaling more than 50% of homeowners do not have the option of a tractor to machine production, for low-end tractors are appropriate for the size of property of small farmers, are not available, and when they are as already described that are imported from other countries which increases its price by the exchange rate of the dollar, and other factors. Negrete 2016

This fact makes the deficit of tractors is more overwhelming for these plots, because for larger parcels enough installed capacity, and the deficit could easily cover with soft loans to farmers and subsidies fuel prices, but for producers with smaller properties, these strategies have no impact on its activity as the capacity of assembled tractors are not obtainable or are profitable for them.

Also in the 2007 National Agricultural Census data found the following;

Total production units	3,755,044
Mechanical drive units	1,142,207
Animal traction units	641,332
Animal traction & mechanical traction	382,397
Hand tools	1,266,142

Table 1 Production units and pull type font used INEGI 2007

What is relevant is the fact that 1,266,142 units of production using hand tools only, possibly indicating that they are reduced in size so you should be equipped with pedestrian controlled power appropriate to its size.

Identification of policies that impact so as to analyze the problems and constraints.

For the agricultural sector of our country can actually leave the current situation of low profitability and poverty, it is necessary to promote agricultural mechanization mainly to increase productivity, the first step is to study the limitations to this, so rethink the actions to be in the future in implementing the most viable strategies and reach a consensus decision-making and not keep making the mistakes of the past.

In Mexico the causes that limitations to agricultural mechanization are;

1. Null or little state performance in executive levels and Missing legislative and legal framework to base and to continuity mechanization policies.
- 2.-Lack of support of the International Credit Institutions
- 3 -. Debate in academic circles about agricultural mechanization
- 4 -. Shortage in the country's iron ore
- 5.-Lack of machines and equipment appropriate to the size of most farms in the country
- 6.-Lack of a clear strategy for agricultural Mechanization

There is no recipe to transfer the technology of agricultural mechanization, for this country should analyze the strategies and the results obtained with them in various countries, such analysis should be done by experts in the agriculture, and after this is done should recommend strategies planners selected national policies. This is the objective of this work; make a first attempt to analyze the strategies to follow for agricultural mechanization in Mexico. to do a literature review, then the analysis of the current scenario is prepared is then the steps to the final strategy is followed, which is described at the discretion of the author, hoping this will serve to make the national strategy by experts and that politicians would take it into account.

Conclusion

FORMULATE STRATEGY

. The resulting strategy should be to define the actions required to move from the current situation to the future situation. Finally, the strategy document clearly outlines the actions and activities, which will assist policymakers and planners to implement the strategy. Clark 2000.

FINAL STRATEGY

It should remove the restrictions already mentioned to mechanization in the country

- 1.- Implement State Performance in the executive and legislative levels and provide a legal framework to base and continue the policies of mechanization.
- 2 .-Ending the debate in academic circles about agricultural mechanization
- 3 .- Encourage the production of iron and promote the skills necessary for the manufacture of tools and equipment such as casting, welding and machine tool management in rural areas.
- 4.- Promote access to machines and equipment appropriate to the size of most farms in the country
- 5.-Analyze current local alternatives to strictly domestic manufacture of agricultural machinery, which are foreign imports or joint ventures with foreign manufacturers for assembly or local manufacture. International OEMs can provide technical and commercial expertise and staff and are often willing to make a significant amount of capital investment required. Have programs of research and development and have good solid experience in establishing

systems and distribution networks. Foreign companies often have a full line of equipment which you can select the appropriate types and sizes for domestic needs. Gifford 2007.

This limitation is removed first favoring proper machinery to import the predominant size property in the country, and also promoting the design of them locally for later manufacture.

Since 1988 as Binswanger reports that the global inventory of farm machinery indicates that there is a huge range of sizes between machines that are used for virtually every type of agricultural operation. Technological innovations have come from European countries and East Asia, where lands are scarce and wages are high. In Japan, the mechanization of farming started with small cultivators, tractors orchards, and the average number of horsepower tractor fleet has not increased much over time.

6.-Implementing a system like the incentive program similar to the mechanization of Brazil called PRONAF (Programme for Strengthening Family Agriculture), which provides credit for the purchase of agricultural machinery with low interest rates, farmers called "family", which are small farmers. Concepts of "family farming" in Brazil are in Machado (2010)

7.-Integration of industry assembly tractor and combines a dynamic growth of the automotive industry in Mexico.

Mexico is a major exporter of tractors in the segment of medium power. Mexico is a leader in the automotive industry. Mexico has high levels of poverty by low productivity in agriculture. Mexico can be a leader in the manufacture of tractors in the segments of low power, combines and cultivators, if the manufacturing industry of these goods is not secreted as a sector as has happened to date, and is integrated into the auto sector, by leveraging its experience, and its advantages as public policies that favor government besides the positive relationship industry where government, academia and industry work together to create synergies and working closer collaborative links that allow the industry to position itself as a leading manufacturer exporter thus saving foreign exchange used to import these units.

Mexico can reduce rural poverty by increasing productivity, being available low power tractors, tractor powered combines and two wheels tractor at affordable prices. Negrete (2014).

References

- [1] Anonymous.-(2001) *Hecho en México, factible el desarrollo de maquinaria agrícola de alta eficiencia* document online access january 2011 <http://www.teorema.com.mx/cienciaytecnologia/hecho-en-mexico-factible-eldesarrollo-de-maquinaria-agricola-de-alta-eficiencia/>
- [2] Bishop C. 1997. *A Guide to Preparing an Agricultural Mechanization Strategy* Food and Agriculture Organization of the United Nations Rome .Italy.
- [3] Binswanger, P. H. y Danovan, G. (1988): *Mecanización Agrícola; Problemas y Opciones*, Washington D. C., Banco Mundial, documento online acceso el 8 de abril de 2005.

- [4] Bolaños, O. M de F.2000. *El Papel De La Mecanización Agrícola Dentro del Desarrollo Integral de la Sociedad. Elementos Para la Planificación de Estrategias de la Mecanización Agrícola. Un Estudio de Caso . NICARAGUA* doctoral thesis . Kassel university press. Germany.
- [5] Cadena, Z.M..1997-”*Situación de la mecanización Agrícola en México en. Maquinaria Agrícola ,Antología”* . 185 p. DGETA, México.
- [6] Clark L.J. 2000. *Agricultural Mechanization Development The Roles of the Private Sector and the Government* FAO 2000 document online access 12 may 2012
http://www.fao.org/fileadmin/user_upload/ags/publications/agr_mech_strat.pdf
- [7] Gifford. R.C. *La Ingeniería Agrícola en el Desarrollo: formulación de una Estrategia para la Mecanización.* Vol 1 concepto y fundamento boletín de servicios agrícolas de la FAO . 99/1 Roma 1993
- [8] INEGI.*Revista del VIII censo Agrícola y Ganadero.* Document online www.inegi.org.mx access febrero 2011
- [9] Jimenez S.F.et.al.2009. “ *Mecanización del Agro en México*” . Agro.revista industrial del campo No.54 año 8 revista bimestral Dic.08-Enero 09 documento on line <http://3wmexico.com/2000agro/revpdf/agro54.pdf> acceso febrero 2011
- [10] LARA L..A..*Design and Development of a two Wheeled Tractor for production by small scale manufacturers in México.* Doctoral Engineering Dissertation University of California .Davis California USA 1979
- [11] Machado, A. L.T., V. dos Reis e T. Machado2010. *Tratores para Agricultura Familiar guía de referencia,* 124pp., Pelotas, R.S.,Brasil, Ed. Universitaria UFPEL
- [12] Masera, O. C. *Crisis y mecanización de la Agricultura Campesina,* Edit. El Colegio de México. México 1990.
- [13] Negrete J .C .R. 2006 *.Mecanización Agrícola en México* México, D.F. : Edición propia. 123p. 2006
- [14] Negrete,J.C. Machado A.L.T.,Machado R.L.T.. *Parque de Tractores Agrícolas en México :Estimación y Proyección de la Demanda.* Revista Ciencias Técnicas Agropecuarias, Vol. 22, No. 4. 2013
- [15] Negrete, J C.R “*Rural Poverty and Agricultural Mechanization Policies in Mexico*”. Journal of Agriculture and Environmental Sciences. Vol. 3 No. 1. 2014
- [16] Paras Jr. Fernando O., Rossana Marie,C. *Amongo Technology Transfer Strategies for Small Farm Mechanization Technologies in the Philippines.* document online access 12 de mayo2012
http://www.agnet.org/htmlarea_file/library/20110726161100/eb570.pdf
- [17] Rasouli F, H. Sadighi, and S. Minaei *J. Agric. Sci. Technol. (2009): Vol. 11: 39-48* 39 *Factors Affecting Agricultural Mechanization: A Case Study on Sunflower Seed Farms in Iran.* document online access may 2012

http://www.sid.ir/en/VEWSSID/J_pdf/84820090105.pdf

[18] Rijk A. G. 2012. *AGRICULTURAL MECHANIZATION STRATEGY* document online access may 2012

http://www.unapcaem.org/publication/CIGR_APCAEM_Website.pdf

[19] Salcedo S.1999. *Impactos diferenciados de las reformas sobre el agro mexicano: productos, regiones y agentes*. Red de Desarrollo Agropecuario Unidad de Desarrollo Agrícola División de Desarrollo Productivo y Empresarial CEPAL, Naciones Unidas. Santiago de Chile .