ORIGINAL ARTICLES

A Survey on the Level of Mechanization Development in Sistan and Baluchestan, Iran

J. Shahraki, A. Shahrakizad, M. Yaghoubi, M. Esfandiari

ABSTRACT

The aim of this study is recognition of quality and quantity of agricultural mechanization in order to identifying factors which affecting the development of mechanization in Sistan and Baluchestan, Iran. Data were assembled from Statistics of agricultural Jihad organization. In order to give weight to the mechanization index, it is used multi-branch decision. The results showed that the level of mechanization is very low compared to developed countries. Degree of mechanization of harvest operations was too low so that for some of the products was close to zero. Main problem were identified that include low degree of mechanization of operations technology as well as their dispersion and also underlying problems such as lack of irrigation networks as well as inappropriateness the machines with the required technology. Therefore, it is suggested providing strategies such as integration of lands, providing technology according to farm size, conducting education and promotion classes, encouraging and supporting service companies mechanized for providing and expanding of machines and tools and technology in the region in order to boosting the status of mechanization.

Key words: Agricultural Mechanization Development, Degree of Mechanization, Mechanization Level, Sistan and Baluchestan

Introduction

Technology increase labor, water and land's productivity and it is one of the most important ways in order to supplying the world's food. Agricultural mechanization plays an important role, so that it can increase food supply through increasing either boosting the level of operations or increasing production per unit. Therefore, the development of agricultural mechanization and its elements affecting should be considered in agricultural development planning. Agricultural mechanization, can define as the level of using the equipment, mechanical devices or technology in order to increasing agricultural productivity to achieve sustainable development. Thus, technology is not the only factor that can help to desired goals. In fact, it is a more important issue acceptance and application of this technology by farmers. Development of agricultural mechanization includes all aspects of the biological technology, improving the quantitative and qualitative of mechanical technology, efficiency of agricultural production and also the human resources. Development of agricultural mechanization is related to economical-social conditions, technical knowledge of farmers as well as the industrial development of countries. But, it is obvious that use of this technology in agriculture, requires an appropriate technically, economical and social conditions in order to providing the proper use of them. Therefore, any planning related to using technology should be according to regional and local conditions considering technical issues. Any planning can cause loss of capital and wasting time without paying attention to basically studies. Therefore paying attention to this issue is necessary especially in developing countries regarding limited foreign currency. The vision, cultural trends, economical and social livelihood conditions are different in any region and therefore it is not suitable use a general model. Thus, any region need to a special strategy and mechanization pattern. Note Sistan and Baluchestan is a poor province in term of many conditions, it is not clear the status of mechanization of agriculture to the relevant the authorities. So that, any planning in this area can be difficult due to the lack of enough information. Therefore, it is essential a comprehensive analysis study in this field. This study evaluates the status of agricultural mechanization and its impacts on sustainable development; Furthermore, it has provides a solution to improve agricultural mechanization in Sistan and Baluchestan province, Iran.

Table 1 shows the status of machinery during the fourth development plan in 2004-2009. Types of agricultural machinery from 2004 to 2009 years show a gradual increase in the number of machines.

In follow, the most important researches are mentioned. Turkamani and AzinFar (2007) evaluated the impacts on employment growth and export of labor mechanization in the agricultural sector, Iran. The main
The objective of this study is mechanized on the impact of new technology in agriculture. The results indicated there is a negative relationship between growth rates of employment growth and machine technology.

Table 1: The status of machinery during the Fourth Development Plan in 2004-2009.

<table>
<thead>
<tr>
<th>Types of Machine</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combine tractor</td>
<td>4582</td>
<td>4938</td>
<td>5525</td>
<td>5992</td>
<td>6516</td>
<td>6600</td>
</tr>
<tr>
<td>Combine corn</td>
<td>7</td>
<td>13</td>
<td>17</td>
<td>42</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>Tyler</td>
<td>20</td>
<td>27</td>
<td>33</td>
<td>56</td>
<td>58</td>
<td>66</td>
</tr>
<tr>
<td>Mowing car</td>
<td>351</td>
<td>420</td>
<td>544</td>
<td>575</td>
<td>586</td>
<td>593</td>
</tr>
<tr>
<td>Total</td>
<td>4960</td>
<td>5398</td>
<td>6119</td>
<td>6665</td>
<td>7210</td>
<td>7313</td>
</tr>
</tbody>
</table>

Source: Agriculture Organization reports province in 2009

Luyemi and Almasi (2002) examined the situation of mechanization in the north of Ahwaz, Iran. The results indicated that the level of mechanization of 1.1 horsepower per hectare, which however there is a relative desirability, but factor productivity, has been dropped about 40% in wheat's harvest.

Bigdeli et al (2006) assessed the development of agricultural mechanization in Hamedan, Iran. The results showed that, 32 percent of farms are too low, 46 percent are low, 19 percent are moderate, 2.5 percent are high and 0.5 percent is too high in terms of mechanization development level.

Bagheri and Moazzen (2003) evaluated the optimal strategies for development of agricultural mechanization in Iran. The results showed major challenges in the process of mechanization can be classified into four gourps of social, economic, technical and administrative scheduling.

Sadeghi et al (2004) examined factors affecting the development of agricultural mechanization in South Khorasan province, Iran. The results showed that the level of mechanization is 0.41 hp per hectare which is already low compared to developed countries.

History of agricultural mechanization development in other country shows that the 1990s is a landmark in terms of designing, planning and supporting in Food Agricultural Organization (FAO); So that, it is noticeable the role of FAO in strategic projects of mechanization. There are some common properties in the projects of mechanization development which some of these commons are as follow:

1. To use the technology considering the climate.
2. To access new technology through providing credits.
3. To improve farmers' access to new technologies through providing credits.
4. To produce proper equipments.
5. To technically support and maintain machinery, equipment and agricultural equipments.
6. To conduct appropriate meeting in order to proper use of technology, regarding promotion programs.
7. To create information systems to improve farmers' awareness from new technologies.

Other related research has been done in other parts of the world which is pointed the most important ones in follow.

Rijk, Adrianus (1989) had a survey on agricultural mechanization policies and strategies in Thailand. In this project were paid to the structural policies such as the mechanization of agriculture, farm management and technology management as well as patterns of strategic planning for developing agricultural mechanization.

Clarke (1993) assessed strategies in order to developing mechanization in Slovak Republic. It mainly focused on identification and selection of appropriate technologies with attention to its climate as well as stating some strategies in order to development of agricultural mechanization. FAO (1993) had another survey on development of agricultural mechanization in Malawi. In this survey, it is paid to identification and selection of appropriate technology and support which can be necessary in order to developing agricultural mechanization for both public and non-public sectors. The results stated that the large number of development mechanization projects, have transferred technology, but they were unsuccessful due to the lack of attention to economic aspects and localizations issue.

Clarke (1997) surveyed agricultural development strategies for southeast Anatolia. The results indicated they use devices as rent, farmers with small land area which purchase of equipment is not possible for them.

Methods:

In this study, it is used wide holistic (whole-oriented) and depth-oriented methods in order to identifying the present status of mechanization development and determining practical solutions to improve the situation of mechanization.

Coefficient of the dependent variable is the development of agricultural mechanization, which it was used the degree of mechanization, mechanization capacity, labor productivity and net profit per unit area in order to calculating dependent variable. Independent variables were technical factors, farm size, the size and lifetime of the machine, farmer's income, funds, social insurance, age, education, experience, use of information resources, and the number of training courses. It was used the degree of mechanization, mechanization capacity, labor
productivity and net profit per hectare in order to computing the development of mechanization. For
determining the coefficients of each of these indicators, it was applied the entropy and simple set of weighty
method. Then, the decision matrix for each of the city was established as follows:

<table>
<thead>
<tr>
<th>Cities</th>
<th>Factors</th>
<th>X₁</th>
<th>X₂</th>
<th>...</th>
<th>Xₙ</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>R₁₁</td>
<td>R₁₂</td>
<td>...</td>
<td>R₁ₙ</td>
<td></td>
</tr>
<tr>
<td>A₂</td>
<td>R₂₁</td>
<td>R₂₂</td>
<td>...</td>
<td>R₂ₙ</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Aₙ</td>
<td>Rₙ₁</td>
<td>Rₙ₂</td>
<td>...</td>
<td>Rₙₙ</td>
<td></td>
</tr>
</tbody>
</table>

The information of the matrix was normalized by using following relations:

It was used equation 1 for the positive factors:

\[ P_{ij} = \frac{r_{ij}}{\sum_i r_{ij}}, \quad i = 1, \ldots, m \]  \hspace{1cm} (1)

Equation 2 was used for the negative factors:

\[ P_{ij} = 1 - \frac{r_{ij}}{\sum_i r_{ij}}, \quad i = 1, \ldots, m \]  \hspace{1cm} (2)

After data normalization, the following coefficients were used to determine the equation 3:

\[ E_j = \frac{1}{\sum_j |P_{ij}\cdot \ln P_{ij}|/ \ln(m)} \]  \hspace{1cm} (3)

The degree of factor deviation jth (D_j) was calculated by equation 4:

\[ D_j = 1 - E_j \]  \hspace{1cm} (4)

In order to determining the importance weights are used the equation 5:

\[ W_j = \frac{d_j}{\sum_j D_j}, \quad j = 1, \ldots, n \]  \hspace{1cm} (5)

Calculate the normalized matrix, equation 6:

\[ N_{ij} = \frac{r_{ij}}{r_{ij}^{max}} \]  \hspace{1cm} (6)

It was calculated the coefficient of mechanization development for each city through Equation 7:

\[ A^* = \frac{\sum W_j n_j}{\sum W_j} \]  \hspace{1cm} (7)

Degree of mechanization is an index which can evaluate the degree of mechanization of operations in a
particular scope. To calculate the degree of mechanization was used the equation 8:

Degree of mechanization, on a special operation (%): \[ \text{Degree of mechanization} = \frac{\text{The level should be in the operation (hectare)}}{\text{The level in the operation (hectare)}} \]  \hspace{1cm} (8)

It is a basic index which can be used for calculating the development of mechanization. It is equal to total power
in the region to the level in the operation. In other words, it can be evaluated by using equation 9. Note,
coefficient conversion in this equation, is the coefficient of nominal power to drawbar which according to the
ASAE standards is 0.75 to 0.81. But when faced with a lack of information it is recommended equal 0.75:

The level of mechanization (%): \[ \text{The level of mechanization} = \frac{\text{Coefficient Conversion} \times \text{total power}}{\text{The level in the operation (hectare)}} \]  \hspace{1cm} (9)

Results and Discussion

Degree of mechanization is a quantity indicator which can be expressed as a percentage so that, it evaluate
the degree of mechanization of operations in a region. This index reflects the level of mechanization of
operations but not the quality. Therefore, it was calculated according to equation 8. Figure 1 shows the results:
The results show, in planting operations, the highest degree of mechanization belongs to banana (80%) while, the lowest belongs to pomegranate (34%). Furthermore, in maintaining operations, the highest degree of mechanization belongs to pistachio (80%) while, the lowest belongs to banana (23%). But in harvesting operations, regarding to lack of use of machinery, it was close to zero for the majority of crops.

Table 1: The degree of mechanization development for horticultural crops in Sistan and Baluchestan province (2009).

<table>
<thead>
<tr>
<th>Row</th>
<th>Production</th>
<th>The level of mechanization</th>
<th>Planting</th>
<th>Maintaining</th>
<th>Fertilization</th>
<th>Pruning</th>
<th>Crushing branches</th>
<th>Using machinery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tillage</td>
<td>The</td>
<td>Types of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pitting</td>
<td>Sprayer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Date palm</td>
<td>35%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>2%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>Citrus</td>
<td>30%</td>
<td>5%</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>Pomegranate</td>
<td>30%</td>
<td>4%</td>
<td>10%</td>
<td>20%</td>
<td>10%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>Banana</td>
<td>70%</td>
<td>10%</td>
<td>2%</td>
<td>5%</td>
<td>5%</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>Mango</td>
<td>30%</td>
<td>5%</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>6</td>
<td>Pistachio</td>
<td>30%</td>
<td>10%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>7</td>
<td>Apricot</td>
<td>30%</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>5%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>8</td>
<td>Grapes</td>
<td>45%</td>
<td>5%</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>5%</td>
<td>2%</td>
</tr>
</tbody>
</table>

According to equation 2, the level of mechanization in the area is calculated as follow:

\[
\text{Level of mechanization in area} = \frac{(65047 \times 0.75)}{61433} = 0.68 \text{ hp/ha}
\]

As it is obvious, it can be generally said that the level mechanization development is too low.

Conclusion:

The purpose of this study was recognition of quality and quantity of agricultural mechanization for identifying factors which affecting the development of mechanization in Sistan and Baluchestan, Iran. It was used wide holistic (whole-oriented) and depth-oriented methods in order to determining the present status of mechanization development and determining. The results showed that technology has not changed considerable overtime so that the degree of mechanization was 0.68 hp / ha that it show, the level of applying machinery is too low. There are several factors for this problem. Low fertility of land, problems in the underlying issues such as lack of irrigation networks and especially the drainage network due to the relative salinity of the ground, cultural issues about interest in to work hard in farming due to the unfavorable weather conditions and also existence of industrial projects to use human resources instead of machinery, are some of this factors. Low level of technology (degree of mechanization), the small size of farms and also lack of infrastructure facilities are the most problems that have led to lack of using machinery in Sistan and Baluchestan. Furthermore, it was determined that the most important operations, planting and harvesting operations, had a very low degree of mechanization. While, farmers interested in using type of mechanized operations and know positive effect of machinery in the final performance. Regarding to the high correlation between farms size and the degree of mechanization, it is one of the major obstacles in development of mechanization, existence of the small size of agricultural mechanization. To increase efficiency and productivity of the machines, it should note to educational programs as well as supporting services such as construction and equipping of local repair shop and also providing adequate spare and having services after sales. Tractor training and other agricultural machinery to users in order to reducing machine costs, management and scheduling use of machines, proper operation of the farm, supplying facilities for farm irrigation systems and finally leveling of parts, can be effective for improving the mechanization index. Moreover, regarding to mismatching common technologies and equipments to region’s needs, it is suggested research divisions like agricultural research centers be active, so that the obtained results be transferred by relevant institutions to farmers.

References


Reports of Agriculture, Agriculture Organization of Sistan and Baluchestan, 2009.