Selection of Plowing Systems Using Hybrid SWOT-AHP Method (Ijrod city of Zanjan)

Kamran Afsahi*1, Asadollah Akram2, Reza Alimardani3, Majid Azizi4

1. PhD Student of Department of Agricultural Machinery Engineering, Faculty of Agricultural Engineering and Technology, University of Tehran, Karaj, Iran
2. Associate Professor of Department of Agricultural Machinery Engineering, Faculty of Agricultural Engineering and Technology, University of Tehran, Karaj, Iran
3. Professor of Department of Agricultural Machinery Engineering, Faculty of Agricultural Engineering and Technology, University of Tehran, Karaj, Iran
4. Associate Professor of Department of Wood & Paper Sciences and Technology Faculty of natural resources, University of Tehran, Karaj, Iran

*Corresponding author email: kamranafsahi@yahoo.com

ABSTRACT: In order to advise system, the research results cannot be adequate. So for identifying the effective factors in system selecting, the experience of experts should be used. The present study examines the strengths, weaknesses, opportunities and threats (SWOT) of system at plowing in all of the used methods (conventional tillage, Local and abroad Conservative tillage and No-tillage) in planting the wheat in Ijroud city in Zanjan by ranking via the analytic hierarchy process (AHP). According to the expert's ideas, the existing threats like the small size of the farm, the lack of research and qualitative study on new methods and the lack of research and qualitative study on new methods and the lake of governments protection (47 percent) in selecting the methods relative to weaknesses (18 percent), strengths (percent) and opportunities (17 percent) are effective. By considering the effects of SWOT factors, the farmers select the local conservative tillage (27.2 percent). The threats cause that only 19 percent of farmers, by knowing the advantage of conservative tillage and No-tillage, like to select the conventional tillage. In this condition, by utilizing the new laws the threats should be changed to opportunities and strengths, so some items like:- making coordinate the lands,- doing the qualitative tests about new machines,- identifying the government's policy about importing and exporting the crops and the price of the guarantee purchase should be clear before farming.

Keywords: opportunities, strengths, strategic management, threats, weaknesses

INTRODUCTION

The main sources of agricultural crops production, water and land are not always fixing and decrease by the time, whereas by increasing the world population, the need for food, increases too. In development countries, the rate of agricultural crops has been increased up to exporting goods, that is due to correct usage of agricultural machines and trucks by a correct management but in under development countries like Iran, due to financial, technical and social problems, coming with problems impose the high expenses to the farmers. Among the agricultural functions, the plowing has the most expenses and energy consumption. Lots of researches have been done studies about the selection of the best tillage method and the variety results have been published. The best tillage method for water farming of wheat production in Iran is the conservative tillage (Javadi et al., 2009). The deep tillage in water farming of wheat production and the surface tillage in dry farming of wheat production have the best function. Continuing No-tillage system decreases the outcome gradually (Sadeghnejad and Eslami, 2006). Low tillage method with wintry planting cover has the most benefit (Simoes et al., 2009). Conservative tillage for annual multi planting system of corn-wheat in winter is possible and No-tillage by mulch has an effective impact on improving the crops and water consumption (Jin et al., 2009). Among the No-tillage method, mulch method and conventional tillage, the mulch is a useful method (Gomez et al., 2009). No-tillage method decreases the expense of production, controls the growth of weed, helps to save the water and earns benefit (Erenstein and Laxmi, 2008). Tillage in different depth by variety of hooks has an effective and significant result (Manuwa, 2009). The active carbon is sensitive toward the soil managing and conservative tillage in dry farming agriculture by improving the supper substances storage and the biological
characteristics of the soil in a long time can improve the quality of the soil, especially surface layer of the soil (Melero et al., 2009).

According to aforesaid results the exact scientific system is selected. Although some factors such as the regions condition, the price of the machine, farm's size and the knowledge of user about machine are important for effective selection of a system and without considering these factors, identifying the new system is impossible. There is a direct relation among the success in conservative tillage, probable training of farmers, the users of agricultural machines and the people who has a direct relation with the agricultural crops (Lafond et al., 2009). The effective factors should be analyzed by managing methods and by selecting a good method. It can decrease wasting the energy and improving the tendency to buy the new machines. Lots of researches have been studied in the area of the usage of managing methods for identifying the problems and solving them. The researchers have been analyzed the potential of Silvopasture adoption in south-central Florida by using SWOT and AHP (Analytic Hierarchy Process) and explored the strengths, weaknesses, opportunities, threats and their weights (Shrestha et al., 2004). By using the SWOT method, approaching the effective stable conditions has been analyzed in the environmental quality and technical development of Iran that it needs publishing the new political laws (Noori et al., 2006). But SWOT method cannot identify the importance of factors, so it is better to use the net analyzing process (Yuksel and Dagdeviren, 2007). The AHP is a useful and applicable method for making decision, cooperative making decision and increasing the quality and the quantity of knowledge (Schmoldt, 2001). Researchers have been categorized the articles according to its importance by using AHP method (Montazavi et al., 2006). They believed using AHP with one of the analyzing data methods can have a better result (Ho, 2008). Synthesizing of AHP and SWOT method give us a more exact result than use one method (Zaerpour et al., 2008). Utilizing a hybrid method of SWOT-AHP can improve the insight of planning process and explore an exact result (Kurttila et al., 2000). Combining the managing and scientific results can analyze all of the aspects of the issue. Identifying the effective factors on selecting the tillage system by SWOT and AHP and exploring the proper method for improving the correct situation is the aim of this paper.

**METHODOLOGY**

This research has been done in Ljroud city, that is one of the seven towns of Zanjan in the west of Iran and the others are: Abhar, Khoramdareh, Khodabandeh, Ljroud, Tarome and Mahneshan. More than 90 percent of wheat production in Khodabandeh, Ljroud, Abhar and Zanjan are dry farming and more than 70 percent of it is water farming. (The annual statistical magazine in Zanjan, 1390). In this research for selecting the best system among the conventional tillage, local conservative tillage, abroad conservative tillage and No-tillage for wheat production in dry and water farming, the SWOT analyzing method has been used. It is a useful method for identifying the strengths, weaknesses, opportunities and threats.

In this model, threats and opportunities as the environmental factors implying the suitable and unsuitable challenges in the region and strengths and weaknesses as the internal factors imply the lacks and qualifications. This information that collected by interviewing with the expert persons of Zanjan and by using previous studies in the literature. By this way the qualitative effective factors in selecting the system has been recognized and after the inquiries, the date have been qualified by AHP method. In this way by drawing the lines on each four directions by 45 degree on the axis and identifying of each factor according to the weight, the region conditions have been showed (see Fig. 4). SWOT model involves a two-dimensional table that each part implies a category: 1- aggressive category (so), 2- variant category (st), 3- The category with tendency to change the direction (wo), 4- defensive category (wt). In the library study, the important factors according to SWOT, have been noted and the results have been showed that the technical committee that consist of a research director, a mechanical expert, and one experienced farmer. The important factors issued in the region condition, the price of the machines, the farm's size and the knowledge of user about machine have been used by Delphi technique. This method is good at finding creative ideas and it is certain in the making decision. It is used for collecting and categorizing the expert’s knowledge by distribution of the inquiries (Adler and Ziglio, 1996). In this method for predicting the technical future, there is no need to social interaction (Wissema, 1982). The importance of Delphi technique is because of the expert's science and knowledge, not for number of the participants. The statistical population for SWOT analyzing are 69 person that involves the faculty members of agricultural science departments (5 persons), the researchers of research center (3 persons), the experts of mechanization units (34 persons), the farming units of agricultural organization (8 persons) and the expert farmers familiar with the system (19 persons). These farmers usually have more than 20 ha in water farming and 50 ha in dry farming for wheat production. The Kukran formula has been used for identifying the interviewed sample from the general statistical population by drawing. For selecting the tillage system and ranking the SWOT factors, the qualitative method with the aimed sampling from the expert farmers that are directly in the selecting conditions (tillage system), whom the number of them in Ljroud is 19 persons, have been used ranking the SWOT factors and selecting criteria of AHP has been used in this research as the Tomas Saati introduced it for analyzing the
difficult problems and changing them to the easy one. Hierarchy process is a graphical scheme that its goal is on top of it and in the other levels are: criteria, sub-criteria, factors, sub-factors and the choices. The comparison has down from up to down. AHP matrix can be consistent or inconsistent that its inconsistencies label depends on the researcher. According to the Tomas Saaty’s idea, it is equal to 0.1. The expert choice software has been used for analyzing the problems and sensitive analysis. Identifying the strengths, weaknesses, opportunities and threats in a statistical population by AHP resulted in 3 important factors (Fig. 1) that consist of: the criteria of selecting the tillage system identified by AHP and Delphi technique, the price of machine, selling services, the machines width, and the needed power.

Table 1. SWOT factors

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1: Supply and easy usage of tillage machine: using these machines are more easily</td>
<td>O1: The existence of companies forgiving services: There are lots of companies that can help by agricultural services and are supported by agricultural organization</td>
</tr>
<tr>
<td>S2: Consistency with farm: it is consistent with the soil class, the size of land and the lands slope</td>
<td>O2: Bank’s loan: beside the lack of job and high expenses of life, the bank’s loan and services allocated to the farmers</td>
</tr>
<tr>
<td>S3: High function: deducting the time and consumption energy, increasing the soil supper substances, saving the soil humidity</td>
<td>O3: The youth and their tendency to modernity: increasing the number of young farmers, their education and their tendency to modern methods</td>
</tr>
</tbody>
</table>

Weaknesses

<table>
<thead>
<tr>
<th>W1: The soil destruction</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>W2: The machine expense: the machines have a lot of expenses such as stable expense, variant, poisons</td>
<td>T1: The lack of government support: the lack of exact planning such as export, import and ensure purchase of crops</td>
</tr>
<tr>
<td>W3: Adjusting the machine: it is very hard to adjust and use the machines.</td>
<td>T2: The lack of qualitative study: importing the machine has been done without the study, qualitative analyzing, after selling services, so on.</td>
</tr>
</tbody>
</table>

Ranking the SWOT analyzing factors for different systems of tillage by AHP technique after identifying the factors and four SWOT group as the choices have been completed (Figure 1).

The pair-wise comparison of the criteria has been done for each system. According to each criterion, the pair-wise comparison of choices has been done. At the first, the criteria are in a 4×4 hierarchy system and for each criterion in each tillage system the hierarchy is 3×3. So the general hierarchy system in 12×12 involves each four factors. Implementing the matrixes has been done by asking questions from the expert farmers that are the statistical population of the research. According to analyzing hierarchy theory and the importance of each criterion, weighting from 1 to 2 allocated to each one (Figure 2).
Using SWOT, qualitative factors affecting the choice of the system have been qualified and after technical questions, they were quantified using AHP. The weight of each factor has been shown with on-line 45 degrees on the coordinate axes (Fig. 4). Hierarchy ranking of tillage system has been designed in the software. In this process, selecting the system is the goal, so analyzing the SWOT is the agent and the selected items for each SWOT factor is the sub-agent. Thus, the tillage systems have been selected as the choices. Adjusting the EC software, 16 relative weights has been achieved for each system and the final weight of choices has been showed high priority tillage system for Ijroud town.

RESULT AND DISCUSSION

In the comparison of criteria’s weight, the needed power has the upper weight (0.349), (Table 1). The second criteria is for corresponding the machine width with the farm (0.258), the third one is for the price of machine (0.203), and the last one is for selling services (0.192) (Butani and Singh, 1994; Lak and Boghaee, 2011; Alimardani, 2010).

Table 2. The weight of criteria pair-wise comparisons

<table>
<thead>
<tr>
<th>Weight Scales</th>
<th>necessity of Power</th>
<th>Width of Machine</th>
<th>Services</th>
<th>Machine Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional tillage</td>
<td>0.358</td>
<td>0.219</td>
<td>0.332</td>
<td>0.091</td>
</tr>
<tr>
<td>local conservative tillage</td>
<td>0.484</td>
<td>0.134</td>
<td>0.155</td>
<td>0.228</td>
</tr>
<tr>
<td>Abroad conservative tillage</td>
<td>0.484</td>
<td>0.134</td>
<td>0.155</td>
<td>0.228</td>
</tr>
<tr>
<td>No-tillage</td>
<td>0.069</td>
<td>0.544</td>
<td>0.125</td>
<td>0.263</td>
</tr>
<tr>
<td>Average of Scales systems selection</td>
<td>0.349</td>
<td>0.258</td>
<td>0.192</td>
<td>0.203</td>
</tr>
</tbody>
</table>

According to the weight of criteria, for each choice, AHP has been done and in each system the result of adding the weights equals one (table 2). The final weight for each tillage system has been separately drawn on the axis (Fig2).

Table 3. Final weight of systems

<table>
<thead>
<tr>
<th>SWOT</th>
<th>Conventional tillage</th>
<th>Local conservative tillage</th>
<th>Abroad conservative tillage</th>
<th>No-tillage</th>
<th>Average of systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0.049</td>
<td>0.036</td>
<td>0.045</td>
<td>0.044</td>
<td>0.043</td>
</tr>
<tr>
<td>S2</td>
<td>0.045</td>
<td>0.077</td>
<td>0.080</td>
<td>0.042</td>
<td>0.061</td>
</tr>
<tr>
<td>S3</td>
<td>0.046</td>
<td>0.091</td>
<td>0.090</td>
<td>0.048</td>
<td>0.069</td>
</tr>
<tr>
<td>Average</td>
<td>0.140</td>
<td>0.204</td>
<td>0.215</td>
<td>0.134</td>
<td>0.173</td>
</tr>
<tr>
<td>W1</td>
<td>0.052</td>
<td>0.076</td>
<td>0.078</td>
<td>0.041</td>
<td>0.062</td>
</tr>
<tr>
<td>W2</td>
<td>0.046</td>
<td>0.057</td>
<td>0.056</td>
<td>0.062</td>
<td>0.065</td>
</tr>
<tr>
<td>W3</td>
<td>0.046</td>
<td>0.074</td>
<td>0.068</td>
<td>0.069</td>
<td>0.064</td>
</tr>
<tr>
<td>Average</td>
<td>0.144</td>
<td>0.207</td>
<td>0.202</td>
<td>0.172</td>
<td>0.181</td>
</tr>
<tr>
<td>O1</td>
<td>0.046</td>
<td>0.031</td>
<td>0.033</td>
<td>0.103</td>
<td>0.053</td>
</tr>
<tr>
<td>O2</td>
<td>0.046</td>
<td>0.049</td>
<td>0.048</td>
<td>0.087</td>
<td>0.058</td>
</tr>
<tr>
<td>O3</td>
<td>0.046</td>
<td>0.075</td>
<td>0.072</td>
<td>0.052</td>
<td>0.061</td>
</tr>
<tr>
<td>Average</td>
<td>0.138</td>
<td>0.155</td>
<td>0.153</td>
<td>0.242</td>
<td>0.172</td>
</tr>
<tr>
<td>T1</td>
<td>0.120</td>
<td>0.048</td>
<td>0.057</td>
<td>0.110</td>
<td>0.084</td>
</tr>
<tr>
<td>T2</td>
<td>0.212</td>
<td>0.158</td>
<td>0.157</td>
<td>0.153</td>
<td>0.170</td>
</tr>
<tr>
<td>T3</td>
<td>0.245</td>
<td>0.227</td>
<td>0.218</td>
<td>0.189</td>
<td>0.220</td>
</tr>
<tr>
<td>Average</td>
<td>0.577</td>
<td>0.433</td>
<td>0.432</td>
<td>0.452</td>
<td>0.474</td>
</tr>
</tbody>
</table>

According to the expert farmers, the threats, in the conventional tillage, has been dedicated the most weight (0.577). Whereas, the other factors are: weaknesses (0.144), strength (0.140) and opportunities (0.138) (Table 2). The main threat in this system (0.245) is related to the small size of agricultural land. The lack of qualitative study (0.212) and the lost of the government planning in importing and exporting programming and the price of guarantee purchase (0.120) are the other ranks. The result showed that in conventional tillage, the internal factors (28.5) are affected by environmental factors (71.5) and this severe difference is due to the time and the system oldness. This regions farmers can control the strengths and threats and their main problem is the factors that shape the threats (Fig 4- Right-up). The most important factor of SWOT in local conservative tillage has been allocated to threats (0.433) and the other factors are: weaknesses (0.207), strengths (0.204) and opportunities (0.155) - (table 2). The result shows the environmental factors (58.8) have more effect and influence on internal capability (with the 41.2 percent worth). The biggest threats with (0.227), (0.158) respectively related to the small size of the farm and the lack of qualitative study (Fig ure3 left,up).
In the abroad conservative tillage like the local one, the threats has the most worth (0.432) and the others: strength (0.215), weaknesses (0.202), opportunities (0.153) ranks from the second to fourth level (table 2). The environmental factors (58.5) in this system relative to the internal factors (41.5) have the important effect. The biggest threat (0.218) related to the small size of the farm and (0.157) the related to the lack of the qualitative study (Varsa et al., 1997; Winter, 1983). So the result shows there is no meaningful difference between the local conservative tillage system and the abroad one (Fig 4. Right-down). In No-tillage system, the threats (0.452) had the most weight and opportunities (0.242), weaknesses (0.172) and the strengths (0.134) were the other ranks (table 2). In comparison to the internal factors (30.6), the environmental factors (69.4), has the most effect on new system. The small size of farms (0.189), the lack of qualitative study (0.153) and the lack of government supportive planning (0.110), are the other threats in this system. The highest weight of opportunities (0.103) is dedicated to administrative companies and shows that the possibility of changing in the system is increased by these companies (Fig. 4. Left-down).

Table 4. Ranking of tillage systems

<table>
<thead>
<tr>
<th>Selection of system</th>
<th>Conventional tillage</th>
<th>Local conservative tillage</th>
<th>Abroad conservative tillage</th>
<th>No-tillage</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>0.260</td>
<td>0.316</td>
<td>0.215</td>
<td>0.209</td>
<td>local conservative tillage</td>
</tr>
<tr>
<td>W</td>
<td>0.117</td>
<td>0.275</td>
<td>0.293</td>
<td>0.315</td>
<td>No-tillage</td>
</tr>
<tr>
<td>O</td>
<td>0.089</td>
<td>0.181</td>
<td>0.312</td>
<td>0.418</td>
<td>No-tillage</td>
</tr>
<tr>
<td>T</td>
<td>0.405</td>
<td>0.289</td>
<td>0.183</td>
<td>0.122</td>
<td>Conventional tillage</td>
</tr>
</tbody>
</table>

Ranking the systems has been done by SWOT criteria. By considering the strengths (0.316), it is clear that the expert farmers like to select the local conservative tillage (table 3). But by considering the weaknesses (0.315), No-tillage system has selected that shows the farmers knowledge from the advantages of conservative and No-tillage system the weight of opportunities (0.418) imply the reasons of selecting the No-tillage system and it is effect on changing the system. But the farmers again select the conventional tillage when the weight of threats would be (0.405). It is clear that threats prevent the system changing. Finally, by considering the SWOT factors coefficient, the final weight (0.272) is related to the local conservative tillage that show the effect of strength in selecting the system that is higher than the other SWOT factors (Fig. 5). After this method (local conservative tillage), No-tillage system (0.257) is the second selection of expert farmers.
CONCLUSION

Identifying the strength, weaknesses, opportunities and threats in jroud town in Zanjan, the analyzing SWOT method and for ranking, the AHP technique have used. The result showed that by considering the effect of the strength, the expert farmers tendency is to use local conservative tillage, by considering the effect of weaknesses and opportunities, their tendency is to use No-tillage system and by considering the threats their tendency is to use the conventional tillage system. Finally, after the analyzing the SWOT factors coefficient, the jroud farmers tendency (27.2) to use the local conservative tillage system was clear (Javadi, et al.,2009). It is availability, easy to use, it is consistency with the farm conditions, like: it is size, soil, slope and the high efficiency of these machines like decreasing the time and consumption energy-increasing the supper substances in soil and saving the soil humidity are the reasons of this selection (melero et al., 2009). At last it should be noticed that No-tillage system (25.7) is the second method the expert farmers pay attention to it.

REFERENCES