Effect of Modern Barn and Intelligent Control System on Costs And Quality Properties of Tobacco

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ABSTRACT: Now 30-40 percent of the Tobacco cultivation costs are in technology processes, harvest, stringing, curing and manipulation of leaves. High cost of labor and time-consuming cultivation of this plant is the most important limiting factor. This study was carried out for evaluation effect of modern barn and Intelligent Control System on costs and quality properties of Tobacco in technology steps and in comparison with traditional method. This study was done in Tirtash Research and Education Center at 2014 year. Leaves were harvested in 4 picks up cured with 3 treatments (modern barn and Intelligent Control System with rack (T1), modern barn and no Intelligent Control System with rack(T2) and Traditional barn and no Intelligent Control System with leaves stringing (T3). The modern barn had 13-20m$^3$ of space with 3-4 rows of racks. Traditional barn had 70m$^3$ of space and 400 strings in barn. Results showed that Using of modern barn and Intelligent Control System with rack reduced number of labor, costs, labor time and increased quality of tobacco, efficiency and income. Traditional barn and no Intelligent Control System with leaves stringing had the highest number of labor, costs, labor time, and energy consumption. Theses systems can be used to control the production parameters in the curing processes of tobacco leaves. It has characters of convenience, high level of mechanization, high efficiency and low labor cost. Modern barn and intelligent control system can be used for drying of other agricultural products for example: Medicinal Plants, Vegetable, Greenhouse, Aviculture and etc.

Keywords: Agriculture, Barn, Intelligent System, Tobacco, Medicinal Plants

INTRODUCTION

Tobacco is one of the most valuable agricultural and industrial crops which is cultivated in more than 100 countries all over the world with different climate and has a major role in of some of economy them (Tso.,2005). Although Tobacco is counted as an important industrial plant in the world, it has not been paid much attention by researchers because of its negative aspect in cigarette production. Nevertheless, tobacco has different other usage. For instance, nicotine extraction is carried out from this plant in a large scale and tobacco is also used as a model plant in biotechnology (Chawla.,2003). This plant will be able to have more application in production of different materials based on its transgenic parameters (Dimanov, 2001). Around 3.69 million hectares of the world’s lands are under tobacco cultivation. Tobacco curing and stringing are important processes for the tobacco production. To get high quality and reduce the production costs, mechanization facilities are used to the curing process is currently available. As the labor cost increasing, it is essential to reduce the labor and the workload required in process of after harvesting leaves, reduce the fuel consumption and increase the benefits of the tobacco production. Tobacco is a commercial crop in many countries like China, India, Brazil, United States, European Union, Zimbabwe, Indonesia, and etc because of its high economic value. Farmers will do grading based on the quality of the tobacco leaves before taking them into a market. Quality inspection of the tobacco leaves plays a crucial role in quality assurance, since the quality of the tobacco leaves determines the quality of tobacco products (Guru et al., 2011). Tobacco curing is an important process for the tobacco production system. The quality of the cured tobacco leaves is subject to control process of the temperature and humidity in the curing barn. To get high quality and reduce the production costs, automatic control facilities are used to the curing process and many types of automatic controllers are currently available (chen et al., 2009). IRAN has favorable soil and climatic conditions and tradition for growing leaf tobacco. The harvested leaves are all stringing with hand (5/00/000 and 5/000/000 leaves in Flue-cured tobacco and oriental tobacco, respectively),(Mohnszadeh et al., 2014) reported the use of intelligent systems has positive effect on improving the quality and management of
resources. This system is optimal for reduce production costs (cost and number of hours worked. The best way is to use of semi-automatic. (Ahmadi et al., 2012) defined that Using of stringing machine reduced number of labor (88/5%in hectare) and increased number of tobacco containing strings (78% per day) for air-cured tobacco. To make a reliable plan to develop the agriculture of a region, it is important to gain a precise knowledge of the existing situation and the problems facing the development of agriculture. Otherwise, any long-, middle- and short-term plans will be ineffective and finally problematic and they will lead to a waste of capital and time. This is of crucial importance in undeveloped countries because of limited capital and economic depression. However there are many areas with potential for development in these countries. One of the main reasons, and probably the most important one, for this kind of social structure is the dependence of these countries on traditional agricultural systems with a low level of efficiency hence remaining victims of food insecurity. Therefore, attempts to find a solution to enhance the effectiveness of agriculture in the economy of these countries must be taken into consideration as one of the main goals. By definition, the mechanization of agriculture is the “application of mechanical implements or as a whole, the application of the state-of-the-art technologies in agriculture to increase productivity and to reach sustainable agriculture”. There are three specific indices for the study and evaluation of mechanization in different regions. These indices include degree, level, and Capacity of mechanization (Almasi et al., 2000). Tools, implements and powered machinery are essential and major inputs to agriculture. The term mechanization is generally used as an overall description of the application of these inputs (Clarke, 2000). The level, appropriate choice and subsequent proper use of mechanized inputs into agriculture has a direct and significant effect on achievable levels of land productivity, labor productivity, the profitability of farming, the sustainability, the environmental and, on the quality of people engaged in agriculture (Olaoye and Rotimi, 2010). (Starkey, 1998) defined farm mechanization as the development and introduction of mechanized assistance of all forms and at any level of sophistication in agricultural production to improve efficiency of human time and labour. Increased levels of farm power and mechanization is therefore one of the major factors required to increase production. (Chisango and Obi, 2011) highlighted that a series of mechanization phases, following the Fast Track Land Reform in Zimbabwe were poorly planned and chaotically implemented. This investigation was carried out in Matepatepa area of Bindura district in Mashonaland central province to study the situation of mechanization in the region and to analyze the relevant qualitative and quantitative issues. Principally agricultural mechanization involves the use of tools, implements and machines to improve the efficiency of human time and labour. The most appropriate machinery and power source for any operation depends on the work to be done, cultural settings, affordability, availability and technical efficiency of the options. These indications were clearly evident that agricultural mechanization is not an end in itself, but a means of development that must be sustained. Therefore a socially beneficial agricultural production is determined based on a wide range of social, economic and ecological factors. These factors determine whether a technology is practicable, beneficial and sustainable in an area (Olaoye and Rotimi, 2010). (Ozmerzi, 1998) affirmed that the agricultural mechanization level of a country is technically expressed in terms of hp/ha standard being 1.52/2hp/ha, kwh/ha, ha/tractor, number of tractors/1000 ha, equipment weight/ha and mechanical power/total power practicable, beneficial and sustainable in an area (Olaoye and Rotimi, 2010). The applications of the bulk curing barns improve the production efficiency and increase the tobacco farmers’ incomes. However, the recent controllers for the bulk curing barns are labor dependent. Especially when the tobacco leaves to be cured are harvested in various maturity degrees and in various weathers, the required control process of the temperature and humidity in the curing barns varies. And various species of the tobacco leaves need various curing process. The controllers for the bulk curing barns can only control the temperature and humidity by the presetting curing phases. It cannot identify the features of the tobacco leaves to be cured and adaptively control the curing process. As a result, some curing specialists must be present to tutor the control process. That increases the workload and the labor cost for tobacco curing and the quality of the cured tobacco is subject to the specialists’ experiences (Larry, 2008). This study was carried out for evaluation effect of modern barn and Intelligent Control System on costs and quality properties of Tobacco in technology steps and in comparison with traditional method. The developed system was adopted for managing the technology processes for tobacco cultivation.

**MATERIAL AND METHODS**

In this study, we had three treatments: modern barn and Intelligent Control System with rack (T1), modern barn and no Intelligent Control System with rack (T2) and Traditional barn and no Intelligent Control System with leaves stringing (T3). These systems were designed and built in Tirtash Research and Education Center, Iranian Tobacco Company at 2014 year with the following specifications: The barn has Dimensions of 220 cm (Width) × 250-270 cm (Height) × 300-500 cm (Length) with 3-4 rows of racks. Racks were with the length and width 95×20 Cm. This barn has intelligent control system in processing steps of tobacco in phases yellowing, wilting, lamina-drying and stem drying (Fig.1). This section has a fan with a power air movement around 12000-18000 cubic meters per hour and a gas burner with a thermal capacity is 98,000 kcal. Fan and burner were by wires connecting the intelligent control system (T1). Else barn is similar to the first barn but it hasn’t intelligent control system (T2).
T3 treatment was traditional barn without fan and control system and with the following specifications 400 cm (Width) × 350 cm (Height) × 500 cm (Length) (70m² of space) and leaves stringing method by hand. After the construction of tools, tobacco seedlings were transplanted in mid-April. General practices (pest and diseases, weeds) and priming operation were done at the right time. The leaves were placed inside the racks or stringing and then into barns. Then all the leaves were cured in three barns under similar conditions in four Pick up and four replications. After the leaves were cured then were separated according to color, size and quality and then were evaluated. The average price, times of labor, labor number, gas and electricity consumption treatments were measured. Data analysis was performed to compare them using the Mstact program.

RESULTS AND DISCUSSION

Analysis of variance treatments (Table 1 and 2) showed that the treatments evaluated in significant difference in levels 1% and 5%.

Table 1. Analysis of variance (mean squares) the different treatments

<table>
<thead>
<tr>
<th>Gas</th>
<th>Net income</th>
<th>Price</th>
<th>electricity</th>
<th>Labor cost</th>
<th>Time of work</th>
<th>Labor number</th>
<th>df</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>261</td>
<td>1371</td>
<td>0.019</td>
<td>4722</td>
<td>789</td>
<td>75</td>
<td>25</td>
<td>3</td>
<td>Replication</td>
</tr>
<tr>
<td>313425**</td>
<td>5939041**</td>
<td>0.09*</td>
<td>1364837**</td>
<td>162092**</td>
<td>184864**</td>
<td>2146**</td>
<td>2</td>
<td>Treatment</td>
</tr>
<tr>
<td>153</td>
<td>1104</td>
<td>0.014</td>
<td>3510</td>
<td>705</td>
<td>194</td>
<td>36</td>
<td>6</td>
<td>Error</td>
</tr>
</tbody>
</table>

* & **=significant at 5% and 1% level of probability

Table 2. Analysis of variance (mean squares) the different treatments

<table>
<thead>
<tr>
<th>Total income</th>
<th>Total cost</th>
<th>Green Weight of leaves Per barn (Kg/m³)</th>
<th>Environment pollution</th>
<th>Quality efficiency</th>
<th>df</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2535/3</td>
<td>1050</td>
<td>16</td>
<td>9/5</td>
<td>45</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>124020/7**</td>
<td>11758**</td>
<td>2068/7**</td>
<td>3039/7**</td>
<td>1006/5*</td>
<td>2345**</td>
<td>2</td>
</tr>
<tr>
<td>2609/7</td>
<td>1031</td>
<td>4/4</td>
<td>13/5</td>
<td>59</td>
<td>42</td>
<td>6</td>
</tr>
</tbody>
</table>

* & **=significant at 5% and 1% level of probability

Table 3. Mean compare the different treatments

<table>
<thead>
<tr>
<th>Quality (%)</th>
<th>Efficiency</th>
<th>Electricity (Kw)</th>
<th>Price ($)</th>
<th>Labor cost ($/hac)</th>
<th>Labor number</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 a</td>
<td>60 a</td>
<td>1575 a</td>
<td>2.16 a</td>
<td>720 c</td>
<td>87.7 c</td>
<td>T1</td>
</tr>
<tr>
<td>108 ab</td>
<td>45 b</td>
<td>1239.50b</td>
<td>1.9 b</td>
<td>839.2 b</td>
<td>106 b</td>
<td>T2</td>
</tr>
<tr>
<td>100 b</td>
<td>14 c</td>
<td>442 c</td>
<td>1.87 b</td>
<td>1117 a</td>
<td>133/7 a</td>
<td>T3</td>
</tr>
</tbody>
</table>

Table 4. Mean compare the different treatments

<table>
<thead>
<tr>
<th>Total cost ($/hac)</th>
<th>Green weight of leaves per barn (kg/m³)</th>
<th>Environment Pollution (%)</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>853 c</td>
<td>56 a</td>
<td>46 c</td>
<td>T1</td>
</tr>
<tr>
<td>968 b</td>
<td>56 a</td>
<td>61 b</td>
<td>T2</td>
</tr>
<tr>
<td>1186 a</td>
<td>17.5 b</td>
<td>100 a</td>
<td>T3</td>
</tr>
</tbody>
</table>
A) Tim of work:
The results showed that the control treatment (T3) had the highest time of work with a total of 514 hours due to stringing leaves and temperature changes with hand. The treatment of modern barn with intelligent system (T1) had lowest time of work (Fig.2). Use of high level of automation and mechanization reduced hours of work. (Zhang et al., 2013) reported Reduction of working hours on the use of intelligent systems.

![Fig 2. Time of work (hour) in different treatments](image)

B) Number labor, labor and total costs:
Treatments in the number of workers and labor and total costs had significant differences at the one percent level (Table 1). Modern barn, rack and Intelligent system treatment had the lowest number of workers, and costs with 87 number per hectare, labor cost about 720$ and total cost 853$/ hac (Table.3). But T3 treatment had the highest number of workers, and costs. This treatment hadn’t level of automation and mechanization. (Ahmadi et al., 2012) found that use of mechanization reduced costs in tobacco.

C) The quality and Price:
Treatments were different for the average price and quality. Treatment (T1) had the best quality (120%) with price about 2/16$ and (T3) treatment was the lowest average price with 1/80$ and quality (100%) (Tables.3). Modern barn, rack and intelligent system can lead toward a better and more quality of tobacco leaves with the lowest of losses. It can be due to control of uniformity in temperature and relative humidity in barn( Lopez et al., 2005) reported a good quality tobacco leaf used in intelligent and automation systems.

D) The amount of electricity:
T3 treatment had the lowest electricity consumption (442 Kw per hac) due to lack of fan (Table.3), but the other two treatments (T1 and T2) had the most of electricity consumption (1575 and 1239Kw per hac). These treatments had two fans and those worked in curing period for 5-7 days.

E) Gas consumption:
T3 treatment had the highest Gas consumption (1436 m$^3$) due to lack of appropriate control conditions within the room and large space (70M$^3$), but the T1 treatment had the lowest of Gas consumption (876m$^3$), by using intelligent control of temperature and smaller space (13-20m$^3$). (Larry, 2008) and (Lopez et al., 2005) reported reduction of energy consumption in the use of intelligent systems (Fig.3).

![Fig 3. Gas consumption (m$^3$) in different treatments](image)

F) Efficiency:
Treatments were different for the efficiency and in 1% level (Table.2). Barn modern, rack with intelligent system had the maximum of efficiency (60%) (Table.3). This treatment has the lowest labor, energy, costs, Hours of work and wastes. It was the best treatment in the increase of quality and net income. This system had more safety due to control of better from temperature, relative humidity and gas and use of intelligent systems with reaction to update alarms defined for fire and Power outages for human and system. (Mohsenzadeh et al., 2014) reported that the use of intelligent systems has positive effect on efficiency, safety and reduce production costs.
F) Environmental pollution:
T3 treatment had the highest environmental pollution (100%) due to increased gas or oil consumption and greenhouse gases emissions (Tables 2, 4).

G) Total and Net income:
The results showed that the modern barn, rack with intelligent systems had the most Total and net income (2114 and 1333$, respectively) for farmer. It reduced of total cost and increased quality and price of tobacco (Fig.4) Ahmadi et al., 2012 and (Mohsenzadeh, 2014) defined that use of mechanization and intelligent systems in air-cured and flue-cured tobacco increased net income.

H) Green weight of leaves per barn:
Green Weight of leaves per cubic meters of barn had significantly different (Table 2). Barn modern with rack had the highest of green weight of leaves (56.2 Kg) but T3 treatment had the lowest (17.5 Kg) (Table 4). A rack has about 6000gr leaves and string has 1000 gr. Space of modern barn is smaller (13-20m3) Compared with traditional barn (70m3).

CONCLUSIONS
The applications of the modern barn and intelligent system improve the production efficiency; increase the tobacco farmers’ incomes and management of resources. These systems are optimal for reduce production costs. These can be used for drying of other agricultural products for example: Medicinal Plants, Vegetable, Greenhouse, Aviculture and etc.

REFERENCES


Starkey, P. 1998. Integrating Mechanization into Strategies for Sustainable Agriculture Technical Centre for Agricultural and Rural Cooperation (CTA) Wageningen, the Netherlands.

Tso TC. 2005. Production, physiology and biochemistry of tobacco plant, institute of international development and education in agricultural and life sciences, USA.
