A Study of the Development of Agricultural Mechanization in Kunming

Wangyun NING¹, Yulan KUANG², Yonghua ZHANG¹*  
1. Faculty of Engineering and Technology, Yunnan Agricultural University, Kunming 650201, China; 2. Information School, Yunnan University of Finance and Economics, Kunming 650221, China

Abstract Kunming City has entered the rapid development stage of urbanization. In the course of building the urban modern agriculture, the agricultural mechanization of Kunming City is being faced with excellent development opportunity. In this paper, the author scientifically analyzed current development situations of agricultural mechanization in Kunming City and explored existing problems in the course of development. On the basis of analysis, the author put forward recommendations, including increasing scientific research input for agricultural machinery, supporting agricultural machinery enterprises, promoting scientific and technical innovation, taking characteristic industries (such as flowers and vegetables) as pillar industry, speeding up development of modern facility agriculture, and upgrading primary processing of agricultural products. These will play significant role in the development of agricultural mechanization in Kunming City.

Key words Agricultural mechanization, Modern agriculture, Development countermeasures

Kunming City, as the only megalopolis in Yunnan Province, is the political, economic, cultural and traffic center of Yunnan Province. At the great opportunity of building new Kunming, it promotes agricultural modernization in the course of industrialization, informationization and urbanization. Kunming City has launched many modern agricultural park construction projects, which laid solid foundation for industrialized and large-scale development of agriculture. In 2010, the per capita income of farmers rose to the first place in the whole Yunnan Province[1], bringing favorable conditions and opportunities for the development of agricultural mechanization. Therefore, scientific analysis on current development situations and trend of agricultural mechanization of Kunming City during the Eleventh-Five-Year Plan period will play significant role in the development of agricultural mechanization in Kunming City.

1 Current development situations of agricultural mechanization of Kunming City

1.1 Stable rise in possession of agricultural machinery
From the end of the Tenth-Five-Year Plan period (2005) to 2010, total power of the agricultural mechanization in Kunming City rose from 2 452 800 300 watt to 2 700 093 600 watt[3], with an increase of 10.10% in the Eleventh-Five-Year Plan period. Large and medium tractors rose from 9 570 sets in 2005 to 12 245 sets in 2010, with an increase of 27.95% in the Eleventh-Five-Year Plan period. Small tractors grew from 34 268 sets in 2005 to 34 770 sets in 2010, with an increase of 1.46%. The increase in possession of large and medium tractors is much higher than that in small tractors. Stable growth of agricultural machinery optimizes structure of agricultural machinery.

Thanks to richly endowed geographic and climatic conditions, Kunming City has many superior agricultural industries, such as tobacco, flower, vegetable and crops planted in improper seasons. In this situation, the facility agriculture is of special significance. In 2010, there was 3 537.9 hm² of plastic shed[3], 108.4% over 2005 (1 697.6 hm²), reaching an annual growth of 21.7%; in 2010, there was 163.00 hm² plastic greenhouse, 291.8% over 2005 (41.6 hm²), realizing an annual growth of 58.4%.

1.2 Gradual improvement of comprehensive operation level of agricultural machinery
In 2010, total sown area of major crops in Kunming City reached 421 000 hm²[4], area plowed by tractors was up to 200 822.5 hm²[3], accounting for 47.7% of the total sown area, 27.3% over 2005 (which was 20.4%). The area sowed by machines reached 200 hm², accounting for 0.05% of the total sown area, 1.35% lower than that in 2005. The area harvested by machines reached 9 153.3 hm², accounting for 2.17% of the total sown area, 0.13% lower than that in 2005. The area irrigated by machines reached 82 445.1 hm², accounting for 19.58% of the total sown area, 8.72% higher than that in 2005. The area of plant protection by machines reached 77 379.1 hm², accounting for 18.38% of the total sown area, 10.42% higher than that in 2005. In the Eleventh-Five-Year Plan period, the comprehensive operation level of agricultural machinery was improved. The highest speed is tractor plowing, the next is plant protection by machines, and irrigation by electromechanical equipment. However, the area harvested and sowed by machinery becomes less.

The agricultural machinery operation of Yunnan Province and Kunming City is listed in Table 1. Data shows that the agricultural machinery operation level of Kunming City is higher than average level of Yunnan Province, especially the percentage of tractor plowing.
1.3 Increasingly reasonable input and use of agricultural machinery fund
From the analysis on statistical data of agricultural machinery in 2010, the fund for purchasing agricultural machinery accounts for 73.46% of the total fund for agricultural machinery in Kunming City. In the fund for purchasing agricultural machinery, farmers’ input accounts for 77.39%, central finance input accounts for 21.44%, and local finance, organizations and collective input only accounts for 1.17%. It indicates that agricultural machinery input of Kunming City mainly relies on farmers. With increase in subsidy of the state for purchasing agricultural machinery, farmers have higher enthusiasm. As to the expenses for purchasing machinery, the input of government is limited, but it still guides farmers to purchase advanced, suitable and energy-saving agricultural machinery, realizing the purpose of adjusting agricultural machinery structure through the policy of subsidy for purchasing agricultural machinery. In 2005, the fund for purchasing agricultural machinery took up 81.5% of the total input into agricultural machinery of Kunming City, and farmers’ input accounted for 97.4% of the fund for purchasing agricultural machinery. From comparison, it can be known that, at the end of the Eleventh-Five-Year Plan period, the proportion of the fund for purchasing agricultural machinery to the total fund drops, and the proportion of farmers’ input is also falling greatly.

Table 1 Comparison of agricultural machinery operation between Kunming City and Yunnan Province in 2010 (Unit: hm²)

<table>
<thead>
<tr>
<th></th>
<th>Total area</th>
<th>Area plowed by tractors</th>
<th>Area sowed by machines</th>
<th>Area harvested by machines</th>
<th>Percentage of tractor plowing/%</th>
<th>Percentage of machine sowing/%</th>
<th>Area irrigated by electromechanical equipment</th>
<th>Irrigation percentage %</th>
<th>Area of plant protection by machine</th>
<th>Percentage of plant protection by machine/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunming City</td>
<td>421 000</td>
<td>200 822.5</td>
<td>200</td>
<td>153.3</td>
<td>47.7</td>
<td>0.05</td>
<td>82 445.1</td>
<td>19.58</td>
<td>7 7379.1</td>
<td>18.38</td>
</tr>
<tr>
<td>Yunnan Province</td>
<td>6118 500</td>
<td>1 658 148.6</td>
<td>18 154.3</td>
<td>284.4</td>
<td>27.1</td>
<td>0.3</td>
<td>838 114.4</td>
<td>13.7</td>
<td>1 049 169.7</td>
<td>17.15</td>
</tr>
</tbody>
</table>

Note: data in this table was selected from references [3] and [4].

1.4 Analysis on operating benefits of agricultural machinery
According to analysis on statistical statement of agricultural machinery of Kunming City in 2010, the agricultural machinery operating income of farmer households possessing agricultural machinery took up 97.02% of the total income from agricultural machinery. Thus, farmer households possessing agricultural machinery are major subjects of agricultural mechanization in Kunming City.

The total income from agricultural mechanized operation accounts for 85.18% of the sum of income from agricultural mechanized operation, agricultural machinery repair and others. Among this, the income from field work accounts for 19.46%, the income from primary processing of agricultural products accounts for 18.25%, and the income from agricultural machinery transportation accounts for 62.29%, as shown in Fig.1. Fig.2 illustrates the trend of income from agricultural mechanized operation of Kunming City from 2008 to 2010. It shows the income from primary processing of agricultural products and the income from agricultural machinery transportation are rising, while the income from field work takes on a declining trend.

Fig. 1 Percentage of income from agricultural machinery operation in Kunming City in 2010

Fig. 2 Trend of income from agricultural mechanized operation of Kunming City from 2008 to 2010

2 Existing problems of development in agricultural mechanization of Kunming City

2.1 Low level of mechanized operation and small area of agricultural machinery operation
In the Eleventh Five-Year-Plan period, the tractor plowing area in Kunming City takes on a declining trend, while it has a high growth rate in 2009 and 2010. The area sowed by machines fluctuates greatly, but the overall level is declining. As to the area harvested by machine, there is a great amount of decrease in 2010. For the area irrigated by electromechanical equipment, it takes on an increasingly rising trend.

As regards the area of plant protection by machinery, it nearly stagnates in four consecutive years, but it has a great breakthrough in 2010. These show that mechanized operation area of Kunming City lingers in recent years, and the details are listed in Table 2.

2.2 Unbalanced development of mechanized operation level
The unbalanced development of mechanized operation level in Kunming City is mainly manifested in different crops and counties. The statistical data of 2010 indicates that mechanized operation of Kunming City is mainly tractor plowing, mechanical harvesting is mainly concentrated on rice and wheat, and mechanical sowing is still at the popularization stage. Large area of tractor plowing and mechanical harvesting is in Xundian, Luquan and Yiliang coun-
The tractor plowing area of Xundian County accounts for 17% of the whole city, and mechanical harvesting area accounts for 51% of the whole city; tractor plowing area of Luquan County accounts for 16% of the whole city, and mechanical harvesting area accounts for 6% of the whole city; tractor plowing area of Yiliang County accounts for 11% of the whole city, and mechanical harvesting area accounts for 19% of the whole city. In Kunming City, 6 counties still have no mechanical harvesting area. Thus, it shows unbalanced development of agricultural mechanized operation in different districts and counties. In Kunming City, mechanized operation level is high in grain crops, such as wheat, rice, maize and potato. The wheat has basically realized tractor plowing and soil preparation. By 2010, the mechanical sowing area accounts for 4.2% of tractor plowing area of wheat, and mechanical harvesting area accounts for 9.6% of the tractor plowing area of wheat. Rice has realized tractor plowing and soil preparation. By 2010, the mechanical harvesting area takes up 10.7% of the tractor plowing area of rice. However, direct sowing and rice seeding are still difficult problems to be solved. Mechanical sowing and harvesting of maize and potato are still at the test stage.

Characteristic crops of Kunming City include flue-cured tobacco, flowers and vegetable. Tobacco planting in some counties and districts has realized tractor plowing and soil preparation, factory seedling raising, mechanical transplantation, and intensive tobacco curing-room. Flower and vegetable are superior and characteristic agriculture in Kunming City. The facility level is high, but mechanized operation level of companies and farmers vary greatly. Farmers depend largely on low end plastic sheds, and plowing, seeding and field management and harvesting basically rely on manual power, leading to extremely low mechanized operation level. Companies mainly use greenhouse to plant, so their plowing, seeding, and irrigation have high mechanization level, but the harvesting, classification and separation still depend on manual power.

### Table 2 Statistical data of agricultural machinery operation area in Kunming City from 2005 to 2010 (Unit: hm²)

<table>
<thead>
<tr>
<th>Year</th>
<th>Area plowed by tractors</th>
<th>Area sowed by machines</th>
<th>Area harvested by machines</th>
<th>Area irrigated by electromechanical equipment</th>
<th>Area of plant protection by machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>153 347</td>
<td>543</td>
<td>9 008</td>
<td>42 019</td>
<td>30 803</td>
</tr>
<tr>
<td>2006</td>
<td>162 093</td>
<td>2 372</td>
<td>10 633</td>
<td>32 569</td>
<td>33 047</td>
</tr>
<tr>
<td>2007</td>
<td>161 343</td>
<td>603</td>
<td>11 617</td>
<td>30 543</td>
<td>23 311</td>
</tr>
<tr>
<td>2008</td>
<td>151 254</td>
<td>1 520</td>
<td>11 947</td>
<td>41 427</td>
<td>26 077</td>
</tr>
<tr>
<td>2009</td>
<td>180 574</td>
<td>292</td>
<td>12 697</td>
<td>47 285</td>
<td>29 178</td>
</tr>
<tr>
<td>2010</td>
<td>200 822</td>
<td>200</td>
<td>9 153</td>
<td>82 445</td>
<td>77 379</td>
</tr>
</tbody>
</table>

Note: the above data comes from agricultural machinery statistics of Kunming City from 2005 to 2010.

### 2.3 Less input into scientific and technological research of agricultural machinery, and science and technology of agricultural machinery not suitable for social demands

The soil in Kunming City is special, has high cohesiveness and specific resistance, so it has special requirement for agricultural machinery. In Yunnan Province, the industrial level of agricultural machinery is not high, and local agricultural machinery enterprises are few. As a result, agricultural machinery products and quality fail to meet demands of farmers. The basic reasons for this are serious lack of research fund, technical talents, and relatively backward of agricultural machinery research, development and production.

Agricultural machinery and tools for agricultural production are mainly purchased from other provinces, so it may not suit local soil and agronomic requirements, and consequently impair farmers’ enthusiasm of using agricultural machinery.

### 3 Development countermeasures for agricultural mechanization in Kunming City

#### 3.1 Improving social service level of agricultural machinery

In 2010, Kunming City had 43 service organizations for agricultural machinery, 1 agricultural machinery professional cooperative, 74 857 agricultural machinery households, of whom 13 households are large agricultural machinery households with original value of agricultural machinery higher than 500 000 yuan. It shows that social service level of agricultural machinery in Kunming City is still very low and fails to bring into play its due function in agricultural production and rural economic development. Therefore, all levels of government and competent authorities should pay close attention to the development of social service of agricultural machinery, make favorable policies in fund, technology and information, and provide guidance and support in the development of agricultural machinery service organizations.

#### 3.2 Promoting land circulation to realize large scale operation

To realize agricultural mechanization, it should solve the problem of small scale of land operation resulted from fixed output to households, promote land circulation and realize large scale operation. Most rural areas of Kunming City are located in mountainous or semi-mountainous area. Farmers have little and scattered land, leading to great difficulty in agricultural mechanized production. If farmers’ land in the same area is centralized together and circulated to companies, companies can conduct uniform operation and management, build modern agricultural park, and realize mechanized production. This not only raises the utilization efficiency of agricultural machinery, but also reduces utilization cost of agricultural machinery, and increases labor productivity. Some rural labor forces can work in agricultural parks through training, and surplus labor forces can migrate to cities, realizing multiple-channel income creation and increasing farmers’ income.

#### 3.3 Increasing input into scientific research of agricultural machinery to promote scientific and technological innovation

In line with soil characteristics and agronomical requirements of Kunming City, it is recommended to integrate agricultural machinery...
ery and agronomy, conduct research of new agricultural machinery technologies, develop new agricultural machinery, research small and portable machinery suitable for mountainous and semi-mountainous areas, and research and develop facility agricultural machinery and agricultural by-product production and processing machinery that have agricultural characteristics of Kunming City. The key is to strengthen scientific research and innovation, carry out effective communication and connection between agricultural machinery research, popularization department and agricultural machinery production and operation organizations, jointly tackle difficult problems, research and manufacture agricultural machinery suitable for local conditions, improve agricultural production efficiency, and increase farmers’ income.

Besides, it should establish scientific, reasonable and proper mechanical operation codes and agronomical standards, and take mechanical adaptability as important target of scientific breeding and cultivation model, to promote integration of agricultural machinery and agronomy. Furthermore, it should integrate scientific research resources of agricultural mechanization, and jointly tackle key problems in agricultural machinery badly needed by agricultural production, to raise the level of agricultural machinery technological integration. For example, it is recommended to popularize agricultural mechanical technologies for key links of major crop production, and popularize varieties and planting models suitable for mechanized operation[6].

3.4 Speeding up development of modern facility agriculture

Kunming City is the largest production base and transaction distributing center of fresh cut flowers in China. Its "Dounan Flower" is well-known throughout the country. In 2009, flower planting area in Kunming City reached 10 333 hm²; the fresh cut flowers were up to 4.27 billion pieces, and the output value up to 2.68 billion yuan; the area, output and output value account for 66%, 76% and 73% of Yunnan Province; the output of fresh cut flowers in Yunnan Province has ranked the first position in China for consecutive 16 years[7]. Similarly, vegetable industry of Kunming City has become a pillar industry for increasing agricultural production efficiency and farmers’ income, and promoting rural economic growth. By 2009, vegetable planting area reached 76 867 hm² in Kunming City, total output up to 2.265 million tons, total output value up to 5.5 billion yuan, and vegetable output value accounting for 17.1% of the total agricultural output value. In vegetable production areas, per capita income of farmers from sales of vegetable gets to 4 179.1 yuan, the production scale of "company + base + farmer household" up to 2 800 hm², and order production area of enterprises up to 7 733 hm²[8].

Excellent infrastructure and advanced technical equipment are precondition of stable and high yield of flowers. To build unique urban agricultural economy of Kunming City, it should constantly increase flower and vegetable output and improve quality, and popularize advanced and practical technologies of modern greenhouse, factory-based breeding, and water conservation and irrigation. Kunming City has serious problem of water shortage. In production bases and demonstration parks of flowers and vegetables, it should strengthen construction of water conservancy and conservation facilities, reinforce construction of facility agriculture, and build intelligent temperature and humidity adjustable greenhouse, to effectively regulate market demands, increase output and improve quality of flowers and vegetables, realize nuisanceless production of vegetable, and increase farmers’ income.

In addition, it is feasible to popularize plowing, sowing and harvesting machinery in facility sheds, realize whole-process mechanized production of flower and vegetable, and increase output and improve quality of flowers and vegetable. Relevant organizations should actively research and develop equipment for mechanical separation, mechanized packaging, and intelligently controlled freezing storage, to realize standardization and specialization of flower and vegetable production.

4 Conclusions

Kunming City stays at the key period of improving urbanization and internationalization. In the process of building urban modern agriculture, Kunming City welcomes a good opportunity of high speed development of agricultural machinery. In Yunnan Province, Kunming City’s agricultural machinery development ranks the first position, but it still has a big gap with the whole country level. Agricultural development of Kunming City has great space and potential. On the condition of stably lifting agricultural machinery level of major crops, it is preferred to develop characteristic agricultural mechanization according to features and requirements of Kunming City’s urban modern agriculture, to effectively promote rapid development of agricultural machinery in Kunming City.

References


