Crop institute of Ningxia Agricultural Academy was set up in 1950. It includes wheat, rice, maize, variety resource, biology, economic crops, and cultivation improvement etc. 7 research groups. It mainly carries on the research of new varieties and its cultivation technology for wheat, rice, maize, miscellaneous grain crops and benne, sunflower, bean economic crops. There are 30 hm² land for experiments.
Ningxia is located on the loess tableland (north latitude 35° 14'-39° 23', east longitude 104° 17'-107° 39'), at the middle-up steam of Yellow River. The total area is 66,400 km². Among the total area the Yellow River irrigated area is 41%, the southern mountain area is 51%. The total population is 5,800,000.
Geographical location and region feature

**Yellow River irrigated area:** It is in aridity region of middle temperate zone. It is a river flat with the irrigation-silting soil. The layer of soil is deep. There are perfect facilities of irrigation-drainage which keep gravity irrigation very well. The average land per person is small with fine cultivation. The level of farm mechanization is relatively high. Main crops are wheat, maize, rice and rice.

**Pumping irrigation area:** It is also in aridity region of middle temperate zone. Use pumping water from Yellow River to irrigate land. It is new immigration area. Farm mechanization level is low. Main crops are wheat and maize.

**Southern mountain area:** It is cool area of aridity region of middle temperate zone. Farming relays on rain fall and well or reservoir irrigation with coarse cultivation. Farm mechanization is pool. The main crops are maize, tomato, wheat and miscellaneous grain crops.
<table>
<thead>
<tr>
<th>Area</th>
<th>River irrigated area</th>
<th>Pumping irrigation area</th>
<th>Southern mountain area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude, m</td>
<td>1100~1300</td>
<td>1250~1500</td>
<td>1600~2000</td>
</tr>
<tr>
<td>Rainfall, mm</td>
<td>&lt;250</td>
<td>250~400</td>
<td>450~550</td>
</tr>
<tr>
<td>Frost-free period, day</td>
<td>155</td>
<td>140</td>
<td>120~140</td>
</tr>
<tr>
<td>Accumulated temperature ≥10℃</td>
<td>3200~3300</td>
<td>2900~3100</td>
<td>2100~2500</td>
</tr>
<tr>
<td>Type of soil</td>
<td>River flat</td>
<td>Sand-loam</td>
<td>Heilu soil</td>
</tr>
<tr>
<td>Average land hm²/person</td>
<td>0.07~0.13</td>
<td>0.13~0.2</td>
<td>0.2~0.25</td>
</tr>
<tr>
<td>Mechanization level</td>
<td>higher</td>
<td>lower</td>
<td>pool</td>
</tr>
<tr>
<td>Main crops</td>
<td>Wheat, maize, rice</td>
<td>Maize, wheat</td>
<td>Tomato, maize</td>
</tr>
</tbody>
</table>
Maize production and machinery usage

Total grain growing area is 800,000 hm². Wheat, maize and rice are three main crops. Recent ten years maize growing area increased very quickly. Its planting area was reached 200,000 hm². It is 24% of total land but 35% of total output.
Main planting models:
——Only maize:

The yield is around 12,000 kg/hm². Sowing is by machine. Cultivate, weeding, and fertilizing has been basically mechanized. But harvesting was mainly by labor.
--- Wheat and maize interplanting model:

Sowing wheat in early spring with maize sowing band left. After wheat seedling emergence, maize was sown by spot seeding or mini man power drill. Cultivating, weeding, fertilizing were by hand. The wheat harvesting was by machinery, whereas the maize harvesting is by hand since short of machinery. The yield of wheat is 4,500 kg/hm$^2$, maize is 8,000 kg/hm$^2$. 
Plastic film covered sowing model:

Sowing, film covering, weeding, fertilizing, harvesting all are doing by hand. The maize yield is 6,000~7,000 kg/hm².
—— Maize for silage model:

Since the government policy-‘return land from grain growing to forest and grass growing. Then the feedstuff becomes shortage. That push the silage maize has developed quickly. The river irrigation area is the main dairy industry area. The yield of whole fresh plant of maize is 85,000~95,000 kg/hm². The sowing and processing machinery was equipped. The silage maize harvester is not popularized. So it costs much labor work.
Cultivation management

There are many problems for fertilizing. The useful rate is less than 40%. It also costs lot of labor. The result is more yields but less income. The applying fertilizer according to the soil survey is on the way to practice. But without the machinery support, the useful rate can not be improved.

The seed waste is serious. The popularization of technology of precision hill drop sowing was slow. At present, there are 8~10 seeds per meter. After the establishment of the plant, 50% of seed will be wasted. The labor input is very high; it needs 360 labor-day/hm² for wheat-maize model; 240 labor-day/hm² for only maize model. If the labor cost was calculated the farmer income will be very low.
The field experiments for maize breeding

The economy of Ningxia is dropped behind. Its seed breeding keeps traditional method. The main processes of maize breeding are in the following:

The field experiments for improving the cultivation

The suitable cultivation for high yield, high quality, and high efficiency variety is absolutely necessary. *It needs field experiment to find the best of fertilizer level, applying time, plant density, farming model, safe sowing period, and optimum coupling effect of fertilizer and density, ridge culture, water saving irrigation, plant diseases and insect pest's control.* At present we mainly relay on manual work.
Developing strategy

We have purchased a few field experiment machinery. It obviously improved our work condition. But we found the maize seed planter is not good enough. The evenness of seed distribution could not easily control to meet the experiment design. We are looking for the cultivator with fertilizer distribution device, harvester, emasculating machinery.

In order to reduce farmer heavy labor work and increase farmer income, on the current machinery condition, we worked to select new varieties and high yield cultivation technology. The results are great.
We worked out the super high yield interplanting model of wheat and maize. The interplanting model increased the wide in maize band and increased the density from 75000 plant/hm\(^2\) into 90000 plant/hm\(^2\). The yields reached wheat 5000 kg/hm\(^2\), maize 10500 kg/hm\(^2\).
Since the interplanting model costs more labor work and difficult to use machinery, we advocate to enlarge the single maize plant area. The super high yield maize cultivation technology was popularized. It obviously increases the utilization of machinery and reduced labor intensity.
Aimed at that the applying manure and phosphorus fertilizer too shallow, we combined the plowing and applying fertilizer in the previous year, it has obviously increased the fertile effect.

The row spaces were changed into wide & narrow from even. We selected the variety that can stand high density and has a middle growing tallness instead of the tall and big spike variety. The plant density was increased from 67500 plant/hm$^2$ to 82500 plant/hm$^2$. We worked out the technical regulations of super high yield cultivation that efficiently use the machinery in hand, specified the field care. The yield reached 16500 kg/hm$^2$. 

Only maize
In order to solve the problem of shortage of wheat supply, we also worked out a model. That is changing the spring wheat interplanting in to single winter wheat planting, and sowing the silage maize after the wheat harvesting. That solved the contradictions of human or animal requirements and the grain or feed. The river irrigation area is the tradition spring wheat area. The growing period is not enough two seasons but surplus for one season. In order to use the effective accumulated temperature, we enlarged the winter wheat area. Winter wheat ripped early 15 days around. After wheat harvesting, there are 85 days which is ≥10°C and effective accumulated temperature 1800°C. The silage maize was planted. The yield of fresh whole plant is 50000-60000 kg/hm². That accelerates the combine of crop production and animal production.
Winter wheat following silage maize
According to the research on maize growing feature and animal feeding effect, combined with local condition, we worked out the technical regulation and quality evaluation standard for silage maize. A high oil content maize variety Oil-feed 67 was introduced. That increased the silage maize quality. The yield of fresh whole plant is 105000-135000 kg/hm².
In recent years we breed maize varieties Ningdan 9, Ningdan 11, Introduced Denghai 1, Denghai 3, Sendan 16, Zhongdan 9409, liaodan 565, Nongda 647, Oil-feed 67 etc. maize varieties. For the South Mountain area we introduced variety Denghai 1, Changcheng 706 etc. early rip varieties in 2005-2007. We carried on the competition of super high yield of new maize varieties and selected high density varieties Liaodan 565, Zhengdan 958, Shenyu 21, also suitable interplanting variety Shendan 16 which is tall stover and big spike.
Thanks