垄作地区保护性耕作技术推广与应用

The Expansion and Application of Conservation Tillage in Raised-Bed Planting Regions

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- 摘要：针对垄作栽培模式，结合保护性耕作技术要求，通过6年的反复实践应用，我们确立了高茬覆盖、整秆覆盖、碎秆覆盖三种技术模式，采取了充分利用现有机具作业的多种做法，全县推广面积达41.9万亩，其中，高茬覆盖15万亩，整秆覆盖18万亩，碎秆覆盖8.9万亩，实现了保水、保肥、保护环境、增产增收的效果。旨在推出符合垄作地区的保护性耕作技术模式，农民容易接受的方式方法，快速推广保护性耕作技术。
- Abstract: Aimed at the mode of Raised-Bed Planting and combine the technique request of conservation tillage, we established 3 modes---stubble residual mulch, fell stalk mulch and smashed stalk mulch by practising again and again in the past 6 years. We also achieved the purpose of storing moisture and manure, protecting environment and increasing income by fully using exiting machines.

1、垄作地区保护性耕作技术模式适应性

- 1.1阜蒙县是典型的旱作冷凉风沙区
- 我县位于辽宁省西北部，北靠科尔沁沙漠南缘，属低山丘陵区，主要气候特点：县境处于温带半干旱半湿润气候区，四季分明，日照充足，年日照总数为2638.3h，Adaptability of conservation tillage mode in raised-bed regions
- Fumeng county is typical dryland farming area
- My county lies in the northwest of Liaoning Province, the north of it near the southern margin of Dinghu Horqin desert, which is a hilly area, Major climate characteristics: County is in the area of the semi-arid sub-temperate climate, four distinct seasons,abundant sunshine, a total sunshine is 2638.3h every year,

多年平均降水量498㎜。冬季长而寒冷，干燥少雪；夏季短而炎热，雨量集中，春秋温度变化快，温差较大；全县年平均气温7.4℃，无霜期150天左右，干燥度≥1.5，侵蚀数3000—5000t/km2，年表土流失程度2.5—4㎜。土质瘠簿，土壤有机质0.7—1%，是典型的旱作农业区，全县现有耕地面积312万亩，玉米为主要作物，种植面积160万亩，占粮食作物种植面积的80%，近两年玉米平均亩产380㎏左右。

average 498 mm of precipitation.The long cold winter, dry and lack of snow;Short and torrid summer, Spring and autumn temperature changes faster, difference in temperature is quite large;The average temperature of whole country is 7.4℃, frost-free period reaches to 150 days, dryness degree is more than 1.5,erosion is 3000-5000t/km2 ,the annual topsoil runoff is 2.5-4 mm. Organic compound content in soil is only 0.7%--1%. The plowlands area is 208 thousand ha. The main crop is maize, 80% of all the crops planting area.

1.2垄作技术中亟待解决的问题

- 我县农作物以一年一熟为主，多采取50cm垄距作业，传统垄作技术存在一些共同问题：人畜机具下地次数多，压实土壤，破坏土壤结构，作业成本高；地表长时间裸露休闲，土壤失墒严重、风蚀加剧、肥力下降、水土流失严重、生态环境恶化。由于春季多风、少雨、升温快的自然气候，造成土壤易失墒，十春九旱,干旱缺水已成为制约该区农业生产的瓶颈问题。
- The problem in conservation tillage technique
- Fuxin County is a single-crop a year region of Liaoning province. From traditional agriculture, we can conclude some problem in traditional agriculture:the soil configuration is badly destroyed;The cost of agriculture tillage is very high; Because of long time bareness,soil nutrition is badly lost and the ecosystem environment worsen badly. Draught has become a bottle-neck problem that restricts the development of economy.

专家研究结果表明，垄作土壤贮水能力强，在0.5m深的土层内传统的垄作较平作多贮水15mm，但在干旱条件下，地温和表面积的增加使土壤每天的蒸发量比平作多蒸发0.73mm，因此垄作栽培，必须采取降低土壤蒸发的各种有效措施和减少进地作业次数，才能充分发挥垄作栽培的优势，扬长避短，提高效益。

From some research, we can see that soil in the mode of raised-bed planting has strong storing water capability. But in a dry situation, soil also has strong transpiration capability. So, effective measures should be taken to control the moisture transpiration. In this way, the advantage of raised-bed planting can be fully incarnated.

1.3垄作技术与保护性耕作技术相结合必要性

- 旱地垄作在东北地区有着强大的生命力，主要在于春季保苗率高，在当前和今后相当长一段时期内，垄作在保护性耕作技术推广中，有着重要的位置，在机具开发、研制的过程中，从垄作这个前提出发，做到农机与农艺的有机结合，这是一个重要的结合点。
- Necessity of the connection between raised-bed planting technique and conservation tillage technique.
- Raise-bed planting has powerful vitality, mainly lying in to protect the seedling rate in spring high. in currently with aftertime very grow a period, raise-bed planting will have important position in the conservation tillage expansion.In the course of agricultural machine development, attaining organic combine between the agriculture machine and agriculture, this is an important link-point.

垄作栽培开沟起垄，增加了耕地表面积近40%，提高阳光利用率10%－15%，可有效增加积温。垄台起到人工档板的作用，延长雨水入渗的时间，减少径流。有耐旱、抗涝和很强的抗倒伏作用，而且利于杂草的控制，减少对化学除草剂的依赖。

Raised-bed planting increase nearly 40% plowlands enhance the sunlight utilization 10% to 15%. The raised-bed looks like man-made baffle-board,which can prolong rainwater inleakage time. It also can fight a drought, fight a waterlogging and control weed.

保护性耕作技术利用秸秆和残茬覆盖地面，采用少耕、免耕技术，是解决传统垄作保墒问题的行之有效的途径，减少了作业次数，有效地解决了垄作栽培的不足，从而增加农民收入，并且有防止水土流失、冬季保温夏季降温、改善土壤养分状况及土壤生物学性状等的良好生态效果。所以，垄作技术与保护性耕作技术相结合是必要的，有相辅相成的作用，其优点是增温、保墒、聚肥、改土、集流、防蚀，有效地解决了冷凉风沙区地温低、墒情差、肥力薄、水土流失等问题，具有显著的增产效益。

Conservation tillage technique covers the stubbles and straws on the filed and adopts little or no-tillage technology. This technique is an effective method to solve keep entropy problem in traditional agriculture. Conservation tillage technique can reduce the work times, solve the disadvantage in raise-bed planting mode, increase income, and improve soil nutrition status. In conclusion, combine between raise-bed planting and conservation tillage technology is necessary.

1.4三种技术模式的适应性

- (1)高茬覆盖技术模式工艺流程：玉米人工收获——春季根茬处理——精(少)量播种——化学或人工控制杂草——中耕

- Adaptability of three modes
- The technical process of stubble residual mulch mode, maize harvest---- dealing with stubble in the spring---- seeding accurately----getting rid of weed---- cultivation.

(2)整秆覆盖技术模式工艺流程：玉米收获(整秆越冬）——春季秸秆和根茬处理——精(少)量免耕播种——化学或人工除草——中耕

The technical process of fell stalk mulch mode, maize harvest but remain the whole straw---- dealing with stubble and straw in the spring----no-tillage seeding accurately----dealing with weed----cultivation.

(3)碎秆覆盖技术模式工艺流程：玉米收获——秋季进行秸秆和根茬处理——免耕播种——化学或人工除草——中耕

The technical process of smashed stalk mulch mode, maize harvest----dealing with stubble and straw in the autumn---- no-tillage seeding----dealing with weed---- cultivation.

三种技术模式对垄作地区具有普遍性指导意义，首先，是因为符合垄作地区多数农民的耕作习惯。相关资料表明，垄作留茬是东北垄作人工收获的必然做法，秋季根茬含水量高、坚硬，所以，许多农民选择春季用四轮拖拉机带双行灭茬机处理根茬，然后播种。不要秸秆放火烧是现在农村中常见的现象，人工收拾秸秆是最脏最累的活，更是有打工机会的农民所不愿意干的活。

Three modes have instructional significance to raised-bed planting regions.Firstly, these modes accord with a great number of farmers' tillage custom.In the northeast China,raised-bed planting,dealing with stubble and burning off the straws are all their customs.

其次，是因为农民愿意接受应用。农民愿不愿意接受垄作与保护性耕作技术相结合的做法，关键是要看这种做法能否给农民带来利益，在实现正常播种作业的同时，土壤墒情和肥力提高，粮食产量增加，作业环节减少，垄沟秸秆覆盖抑制杂草的生长，减轻了对除草剂的依赖，都给农民带来长久效益。我县保护性耕作生产实践证明，农民愿意接受这种做法。

Secondly, farmers are willing to accept these modes.The key that farmers are willing to accept raised-bed planting and conservation tillage is these modes can bring them advantage.The improvement of soil entropy, enhancement of foodstuff yield and control of weed are all bring farmers long advantage.

2、因地制宜选择保护性耕作作业机具

- 保护性耕作技术推广的关键环节是秸秆处理和播种，选用什么样的机具进行秸秆、根茬处理作业，保证播种质量，关系到这项技术在一个地区能否推开。我们从实际出发，确立了机具作业四个标准：一是采用机具以农民经济承受能力为标准；二是秸秆处理以不影响春季播种质量为标准；三是秸秆覆盖以达到30%以上为标准；四是垄作播种动土量小于30%为标准。
- The key link of conservation tillage is dealing with straw and seeding. The machines we select are related to the expansion of this technique in this region. Base on local fact, we found 4 standards for them to select machines. First,farmer can support it. Second, disposing straw has no influence on seeding in the spring. Third,the straw coverage should be over 30%. Fourth, soil overturn should be under 30%.

2.1高茬覆盖技术模式作业机具

Machine for stubble residual mulch mode

如图1所示，留茬覆盖越冬，是我县乃致垄作地区最常见的作业方式，传统留茬为10—15cm，理论为25—30cm，我们提倡20—25cm，一般在春播前进行根茬处理，推广的作业机具有三种：

As shown in fig.1,stubble residual mulch is a common mode in this region. Traditional stubble height is 10 to 15 cm; Academic height is 25 to 30 cm; The height we advocate is 20 to 25 cm.

Generally speaking, before seeding in the spring we should deal with stubble. There are 3 kinds of machines.

图1 高茬覆盖技术模式

一是直刀切茬精(少)量播种施肥复式作业机具。如图2，可实现春季一次性作业完成根茬处理、播种、施肥作业，减少机车进地作业一次。出苗情况如图3所示。

Double-entry machine can do the works one time, for instance, dealing with stubble, seeding and fertilization. This mode can reduce machines the working times. Seeding circumstances are shown in fig.2 and 3.

图2　切茬播种机作业

图3　切茬播种出苗情况

二是春季用圆盘耙耙压后进行精(少)量播种，如图4，用圆盘耙和镇压器春季进行耙压，重耙一遍，轻耙二遍。出苗情况如图5。

After pressed by disc-harrows, seed accurately in spring as shown in fig.4.The germination circumstances are shown in fig.5.

图4　圆盘耙耙压

图5　耙压播种出苗情况

三是贴茬精(少)量播种作业机具，如图6，错茬播种机，不需要破茬装置，只要选择有较好破茬能力和回土性能的尖角式开沟器就可以，经济实用。

Accurately seeding machine is shown in fig. 6. This machine does not need stubble-broken sets, but appropriate sharp knife opener.

图6　贴茬播种机作业

图7　贴茬出苗

2.2整秆覆盖技术模式作业机具

Machine for fell stalk mulch mode

如图8所示，立秆覆盖地表，冬季放牧牛羊，春季处理秸秆后播种,是我县与内蒙接壤几个乡镇广泛应用的一种形式。我们采用三种作业方式：

As shown in fig.8,covering filed surface with straw and dealing with them in the next spring is the mode that is used widely by many towns. We often adopt 3 modes.

图8　整秆覆盖技术模式

一是春季用圆盘重耙耙压(联合整地机或双行灭茬机)作业，如图9，

Firstly, pressed by disc-harrows in the spring, as shown in fig.9.

图9　园盘重耙耙压

然后应用免耕播种机或普通播种机进行单行播种作业，如10。
After that, seed with no-tillage seeder or ordinary seeder, as shown in fig. 10.

图10普通播种机单行播种

圆盘重耙或普通灭茬机作业后，地表秸秆长的在30cm—50cm，播种后都顺到垄沟里，图11是出苗情况。

After pressed by disc-harrows, straws all fall on the ground.The germination circumstances are shown in fig. 11.

图11　出苗情况

二是春季用秸秆还田机作业，如图13所示，然后用联合整地机浅旋作业，如图14，实现秸秆半掩埋，以防秸秆被风刮跑、集堆，影响播种质量。可采用气吸精量播种，

Secondly, adopt residue coverage machine and combine coordinating machine to deal with straw in the spring, as sown in fig. 13 and 14. This mode can keep straw from blowing away or accumulating.

图13　秸秆还田机作业

图14　联合整地作业

出苗如图15。

The germination circumstances are shown in fig. 15.

图15 气吸播种出苗

三是采用直刀切茬精(少)量播种施肥机直接播种，如图16。秸秆在旋转刀轮的作用下被分向两边，如图17所示，播后苗带无秸秆。

Thirdly,adopt stubble-cutting and seeding accurately machine to seed, as shown in fig. 16. After seeding, there are no straw beside plants,as shown in fig. 17.

图16 整秆覆盖免耕直播

图17 立秆直播后苗带无秸秆

出苗情况如图18所示。

The germination circumstances are shown in fig. 18.

图18　立秆直播出苗

2.3碎秆覆盖技术模式作业机具
Machine for smashed stalk mulch mode

碎秆覆盖技术模式是在秋收后上冻前作业，时间紧且秸秆的湿度相对较大，作业后地表情况如图19所示，

The working time of this mode is deep autumn. At this time, time is limited And straw humidity isvery high. After working,the surfacesituation is shown in fig.19.

图19 碎秆覆盖技术模式

春季播种出苗后如图21，机具作业主要采取三种方式：
fig.19.The germination circumstances are shown in fig. 21. We often adopt 3 modes.

图21 碎秆播种出苗

一是玉米联合收获机作业后，如图20所示，再用联合整地机或旋耕机浅旋处理，也可以用重耙耙压一遍。

Firstly, after working by combine harvester, deal with straw with combine coordinating machine or pressed again by disc- harrows, as shown in fig.20.

图20　联合收获机作业

二是人工收获玉米掰棒子后秸秆站立或割倒，用秸秆粉碎还田机把秸秆打碎，然后浅旋或耙压，将粉碎后的秸秆残茬与浅层土壤混合，防止秸秆被风刮跑。

三是人工收获后用圆盘重耙耙压二遍，第二遍最好是在春季播种前进行，因为春季秸秆含水量低，利于秸秆切碎，并且春季耙压有利于保墒。

- Secondly, after harvesting, smash the straw and press the filed with disc- harrows to keep the straw from blowing away.
- Thirdly, after man-harvesting, press the filed with disc- harrows two times. The second time should be in the spring, because the moisture content is low in spring.

3、推广应用的方式方法

Methods of extending conservation tillage

3.1打破常规，实施两步走战略

一是农民认可的初级阶段；二是扩大推广的高级阶段。迅速建立起冷凉风沙区保护性耕作体系和长效机制，加快保护性耕作技术在北方垄作地区的实施步伐。

Implement two-steps strategy

Implement two-steps strategy, firstly, be ratified by farmers; secondly, widen expansion.

3.2因地制宜，建立有效发展机制

Set up effective development mechanism

- 这一时期，主要是以县乡农机服务站为主体，政府行为占主导地位的发展机制。
- 这一时期是以农机户为主体，市场行为占主导地位的发展机制，这也是我们倡导和继续完善的创新机制。
- At this time, service station is the principal part and governments sit on the key position.
- At this time, the principal part is farmers and market sits on the key position.

3.3实现“五化”管理
“Five turns” management

- 在项目管理上我们坚持做到“五化”：
- 一是制度化。
- 二是标准化。
- 三是现代化。
- 四是规范化。
- 五是可视化。

- On the management, we persist in “five turns” management:
- The first is systemization.
- The second is standardization.
- The third is modernization.
- The fourth is normalizing.
- The fifth is visualized.

3.4靠“四动”来实现

“Four drives”

- 一靠行政推动
- 二靠政策牵动
- 三靠部门发动
- 四靠农民自动

- Firstly,drive by governments.
- Secondly, drive by policy.
- Thirdly, start by department.
- Fourthly, depend on farmers self-motion.

4、结论
Conclusion

- (1) 垄作高茬覆盖采用切茬播种和贴茬播种方式，在东北垄作地区具有一定的推广价值。
- So raised-bed planting mode has expansion worthiness in northeast China.

(2)采用园盘耙、联合整地机、灭茬机粗放式处理秸秆后采用改制的普通播种机单行作业，或用直刀切茬精(少)量播种施肥机直接播种，实现了保护性耕作秸秆处理上的突破,是可行的，使农民手中现有的大量机具参与到保护性耕作中来,值得在其他地区借鉴推广。

after dealing with straw by using disc-harrows, combine coordinating machine and straw- destroy machine, seed with ordinary seeder or stubble-cutting and seeding accurately machine， So the breakthrough of conservation tillage is feasible. This breakthrough provides technique for conservation tillage machine selection and application.

(3)碎秆覆盖秸秆处理的效果农民最容易接受，春季播种可采用单行、双行、三行作业，但作业的成本略高。

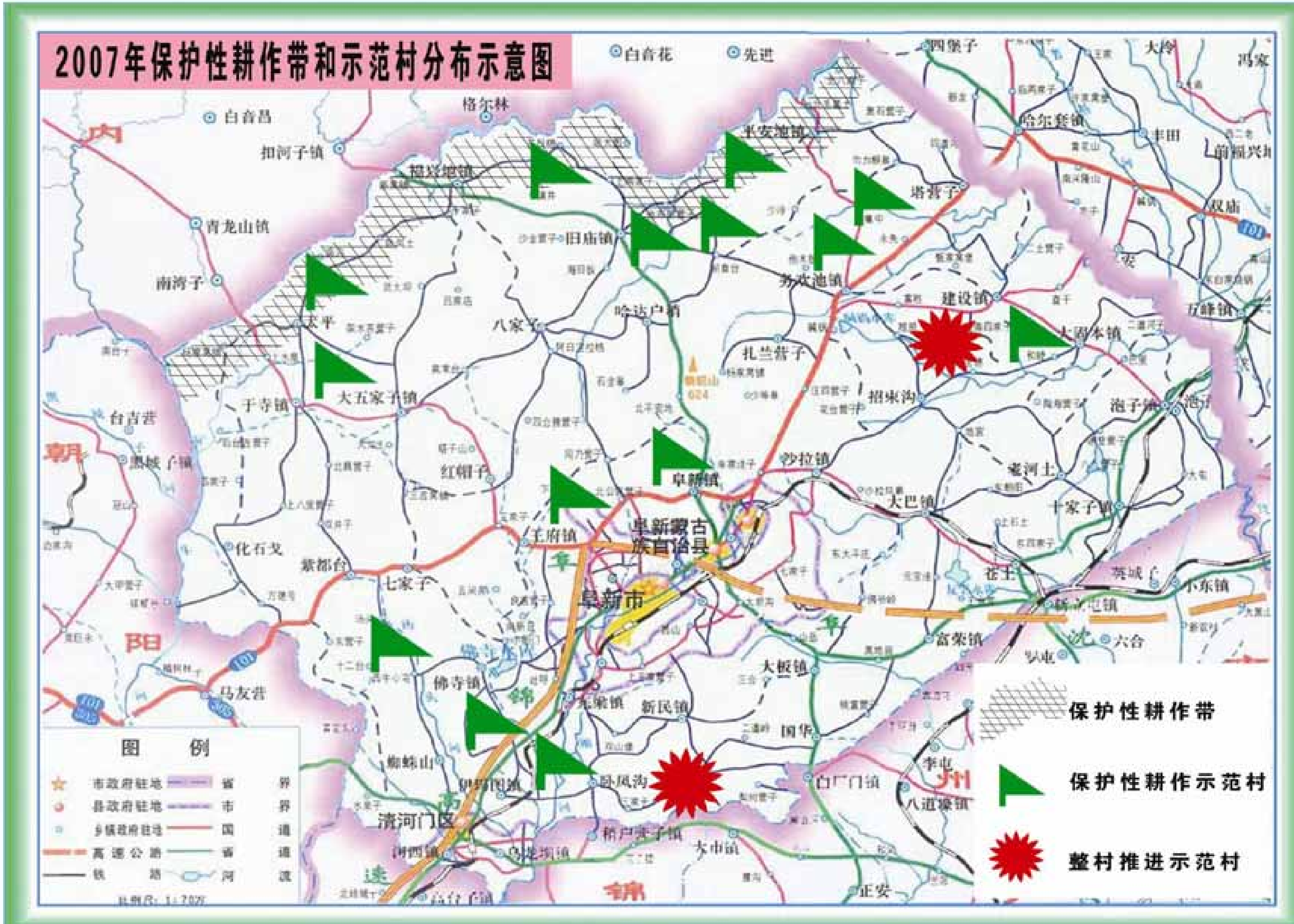
Smashed stalk mulch mode is easily accepted by farmers. We can take single-line, double-line and treble-line modes, but the cost is higher.

(4)我县打破常规，针对不同发展时期推行不同运行机制，一靠行政，二靠政策，三靠技术，通过创造性的工作，促进了农民的自我行动，部分乡镇已建立起长效机制。

My county breaks normal regulations,promoting the dissimilarity movement mechanism to the dissimilarity development period, one depend administration, two depend policy, three depend technique, pass the work of the creation, promote the ego of the farmer act, parts of villages are already build up rise long effect mechanism.

6年多保护性耕作推广的实践证明，我们推广的技术模式符合农民耕作习惯，选择的作业机具经济实用，能够得到多数农民的认可，推广工作中形成的机制运行有效，措施和方式方法贴近百姓实际需求，更贴近保护性耕作技术推广的实际需要，对垄作地区的保护性耕作技术推广具有一定的指导意义。

6 years practice prove that our modes accord with farmers' tillage custom, machines we select are economical, system formed in expansion process is effective, measures and methods accord to farmers needs. This practice also has certain direction meaning.


2007年保护性耕作带和示范村分布示意图
保护性耕作带
保护性耕作示范村
整村推进示范村
图 例
市政府驻地
县政府驻地
乡镇政府驻地
高速公路
铁路
省界
市界
国道
省道
河流
阜新市
阜新蒙古族自治县
清河门区
白音花
先进
白音昌
格尔林
扣河子镇
青龙山镇
南湾子
大平
于寺镇
大五家子镇
八家子
旧庙镇
哈达户稍
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务欢池镇
建设镇
塔营子
招束沟
沙拉镇
阜新镇
红帽子
王府镇
化石戈
紫都台
七家子
佛寺镇
伊玛图镇
卧凤沟
新民镇
大板镇
国华
富荣镇
大巴镇
十家子镇
泡子镇
大固本镇
哈尔套镇
丰田
双庙
四堡子
白音营
黑城子镇
马友营
蜘蛛山
河西镇
乌龙坝镇
大市镇
正安
白厂门镇
李屯
八道壕镇
六合
小东镇
老河土
平安地镇