新疆
阿勒泰地区中低产田研究

杨发相 主编

新疆科技卫生出版社(K)

内 容 提 要

本书三篇八章。着重阐述阿勒泰地区中低产田的形成条件，中低产区、类的划分，中低产田评价体系的建立，中低产田的土壤肥力、用水与种植业生产等主要问题及对策，中低产田的成因与改造途径和措施。

本书可供领导部门、科研、生产和教学单位有关人员参考使用。

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图书在版编目(CIP)数据

新疆阿勒泰地区中低产田研究/杨发相主编.—乌鲁木齐：
新疆科技卫生出版社(K),2001.12
ISBN 7-5372-2928-7

Ⅰ.新… Ⅱ.杨… Ⅲ.农田—中低产田—研究—阿勒泰地区
Ⅳ.S155.4

中国版本图书馆 CIP 数据核字(2001)第 081184 号

《新疆阿勒泰地区中低产田研究》编委会

前　言

阿勒泰地区位于新疆最北部。西、北、东分别与哈萨克斯坦、俄罗斯、蒙古国接壤。辖阿勒泰、布尔津、哈巴河、吉木乃、福海、富蕴和青河等七县(市),国土总面积 11.7699×10^4 km^2,其中耕地 13.635×10^4 hm^{2}①。

阿勒泰是新疆,也是我国重要畜牧业生产基地。同时,也是有色金属矿产开发的后备基地。目前经济以农牧业为主。地区现有耕地中的中低产田面积大,粮食单产低,使地区牲畜饲料和一些边远落后农牧区粮食不能自给。该地区投入产出较低,农业发展缓慢,地方财政匮乏,农牧民生活水平低下。随着地区人口的增加和畜牧业的发展,迫切需要改造中低产田,解决粮食自给有余及转化问题。由于长期以来地区中低产田的类型、数量及主要影响因素不清,农业综合开发事业一直难以在广度和深度上有所突破。经阿勒泰地委、行署与中国科学院新疆分院和原中国科学院新疆地理研究所商议,决定开展"阿勒泰地区中低产田调查及改造途径与措施"研究。1997 年,获中国科学院地方合作基金资助,列为中国科学院高技术企业局《边远地区农业推广示范》研究项目之一,同年,列入阿勒泰地区科委研究计划。目的是为地区中低产田改造治理工程的实施提供系统和全新的科学依据,为提高农业综合开发水平,推动农业持续发展奠定基础。

项目任务由中国科学院新疆生态与地理所承担,阿勒泰地区科委和农业局协作。由杨发相负责,陈祺和赵鸿贵协助。在中国科学院高企局、新疆分院、新疆生态与地理所,阿勒泰地委、行署、科委、农业局及各县市农业局和科委领导的关心指导下,课题组赴各县(市)乡、村调查,广泛收集资料,采集土、水样品化验分析,取得以下主要成果:(1)阿勒泰地区中低产田研究报告;(2)中低产田信息库,内容包括阿勒泰地区中低产田土壤结构与肥力分析资料,阿勒泰地区阿苇滩乡中低产田评价图,阿勒泰地区各县市中低产田类型分布图;(3)论文,包括阿勒泰地区中低产田及其改造措施、阿勒泰地区土地"三化"分析、阿勒泰地区土壤微量元素状况与微肥施用效果等 3 篇;(4)阿勒泰地区中低产田调查相集一册。研究工作基本摸清了阿勒泰地区中低产田的成因、类型、面积及其分布

① 未含新疆生产建设兵团农十师 35 072.1 hm^2。

规律；查明了中低产田的主要因素，并进行综合评价；论述了中低产田的类型特点、土壤肥力、用水及种植业生产结构调整问题；针对中低产田的成因，提出了改造措施。

本书分为八章，第二章由沈玉凌，第四章由李武平，第五章由李国振，第六章由左恒治编写，其余各章编写和统稿工作由杨发相完成。岳健对第二章，李国振对第四章分别进行了修改补充。常青参加制图工作。罗格平对建立中低产田信息库给予了帮助。书中照片9由冯惠生摄，其余照片均由杨发相摄。冯惠生（阿勒泰农广校），齐武山（阿勒泰市农业局），毛文霞、李国萍、李霞、郑彩姬（阿勒泰地区土肥站），阿布都克里木、杨婧（阿勒泰地区科委），李愚超、唐玉清（阿勒泰地区农业技术试验推广站），何文元、陈茂林（哈巴河县科委、农业局），李国勇、吴海良、蒲金珠（布尔津县农业局），刘缤、艾赛提、盖继贤（吉木乃县科委、农业局），曾权勇、杨新卫、给化别克（福海县科委、农业开发办、农业局），吴新元、马哈布力（富蕴县政府、农业局），陈鸿江、牟新、庞华（青河县政府、农业局、扶贫办）等也参加了部分工作。宋郁东、牟振江、张小雷、崔望诚、尹景原（中科院新疆生地所），周俊林、付春利、徐刚（中科院新疆分院），许敏（阿勒泰地区科委），吴晓刚、李洪（阿勒泰地区农业局），周德俊（阿勒泰地区农业开发中心）等领导对课题研究工作给予了大力支持。韩德林研究员对课题的立项与研究均给予了大力帮助。樊自立研究员、陈模教授、王岳涧高级农艺师对研究工作给予了帮助，胡汝骥研究员在本书的编辑出版方面给予大力协助，在此一并致谢。

中低产田生产潜力大，对其改造的经济和生态效益均大于新垦荒地，在水少地多和生态脆弱的干旱区尤其如此，研究和改造中低产田已成为一项十分重要的任务。在如今广泛开展中低产田改造的工作中阐述我们的观点，旨在抛砖引玉。限于工作条件和业务水平，错漏之处，恳请读者指正。

作　者

Study on the Mesoyield and Low-yield Land in Altay Prefecture, Xinjiang

Abstract

Located in the farthest northern part of Xinjiang, Altay Prefecture borders on Kazakhstan, the Russian Federation and Mongolia to its west, north and east respectively. Its total area is 11.7699×10^4 km^2, it is an important production base of animal husbandry and a reserve base of nonferrous metal minerals in China and still relies on agriculture mainly at present. In the prefecture the mesoyield and low-yield land has an extensive distribution, a large area, the multiple formation causes, typicality and strong representativeness in Xinjiang. The book is written based on the collection of reference materials, field investigation, mapping of the types and evaluation of the mesoyield and low-yield land, and analysis of water and soil samples. Its main points are as following:

1. The distribution of mesoyield and low-yield land is extensive and its area is large. The mesoyield and low-yield land is distributed in all counties and one city of the prefecture, the total area is as large as 103 380.6 hm^2 and occupies 75.8% of the total area under cultivation.

2. The yield of mesoyield and low-yield land is low and the proportion of the area of mesoyield and low-yield land is high. The average per unit area yield of wheat was 2 916 kg/hm^2 in the six counties and one city during the period from 1990 to 1997, so the yield of 3 000 kg/hm^2 is regarded as the general yield, and the areas where the yield of wheat is below 3 000 kg/hm^2, stably exceeds 25% of this yield (3 750 kg/hm^2) in successive three years, and can exceed 25% of this yield (3 000～3 750 kg/hm^2) are regarded as the low-yield areas, high-yield areas, and mesoyield areas respectively. According to these classification indexes, totally 33 townships belong to the mesoyield and low-yield areas and occupy 76.7% of the total townships of the prefecture.

3. The main affecting factors of the mesoyield and low-yield land and their types are multiple. There are 8 causes of making poor yield, which include the poor

quality and composition of soil, salinization, cultivated-damp soil, sand drift, slope cultivated land, drought and shortage of water, low temperature, and extensive cultivation. According to these, 8 classifications and 17 subclassifications of soil are classified, and their characteristics are discussed.

4. Land quality is considered at first in evaluation of the mesoyield and low-yield land, then the cultivation level. The evaluated results of the cultivated land quality are revised by on-the-spot investigation. By taking Arweitan Township as a case study, the mesoyield and low-yield land in Altay Prefecture is evaluated based on the evaluation system.

5. The laboratory-tested results of the soil samples are as follows: a. most of the soil structure is harmful, i.e. the thin soil layer and the much sand-gravel soil; b. it is in shortage of nitrogen, phosphorus and potassium in soil, which is different from the conclusion of "it is in shortage of nitrogen and phosphorus but in surplus of potassium in soil" reached in the 1980's; c. it is in shortage of some trace elements, such as zinc, molybdenum, boron, manganese and iron in soil, which provides the scientific data for applying the fertilizer of trace elements.

6. The reduction of crop yield and bad harvest are often caused by shortage of water duo to the temporal and spatial unevenly-distributed water resources, backward irrigation works and irrational water consumption. For these reasons a study on the utilization of water resources and on the countermeasures is carried out, and some measures are put forward; a. to dredge and complete the irrigation and drainage ditches; b. to develop the natural-pressure sprinkling irrigation in the piedmont zone by using the mountainous reservoirs, and to implement the "well irrigation and well drainage" in the riparian areas and the depressions where the drainage is difficult; c. to economize water, to develop the water-economizing agriculture, ensure the water consumption for the ecology, etc.

7. Aiming at the situation of low yield of crops caused by the irrational structure and distribution of planting industry, it is put forward that: a. the distribution should be carried out in line with the local conditions, for example, bean or pea crop should be grown in sand land and paddy should be grown in clay land; b. for the low-temperature mountainous regions and slope cultivated land, it is suggested to withdraw from farming to animal husbandry so as to conserve water and soil; c. for the structure of planting industry, it is suggested to reduce the sown area of cereal crops and enlarge the growing area of industrial crops, green manure crops and alfalfa. The growing area of cereal crops will be reduced for 5.08% and that of in-

dustrial crops will be enlarged for 7.84% in 2010 than that in 1997. Rotation of crops will be implemented and the structure of planting industry will be gradually rationalized. Thus, the purpose of growing crops in line with the local conditions, increasing per unit area yield, forming characteristics, and raising economic returns will be achieved.

8. Formation of mesoyield and low-yield land is related to natural factors, such as morphological conditions, physical and chemical properties and fertility of soil, agrometeorological disasters, water sources, weeds in field, and plant diseases and insect pests, and is also affected by artificial factors, such as the extensive cultivation, low use rate of improved varieties, ineffective prevention and control of weeds, plant diseases and insect pests, irrational structure of planting industry, cultivated-damp soil, swampization and salinization caused by irrational irrigation, low degree of field network of tree lines, and poor quality of agro-ecological environment. The formation of mesoyield and low-yield land is a result of the synthetical impact of natural and artificial factors.

9. The transformation ways of the mesoyield and low-yield land are to improve the quality of cultivated land and raise the planting level. The measures include three aspects, i.e. the administrative, engineering and biological measures. The transformation models are different from the different types. The transformation order is determined by the difficult degree of the main impact factors of mesoyield and low-yield land. Transformation of the mesoyield and low-yield land affected by single factor is easier than that affected by two or more factors, so it should be priorly considered in making the planting of transformation of the mesoyield and low-yield land.

10. By using the analyzed results of trace elements in soil, the experiments of applying the fertilizer of trace elements were carried out in 1999, and the results show that the yield of wheat, corn, soybean, kidney bean and oil-bearing sunflower seeds were raised for 11.37, 12.35, 16.7, 14.7 and 13.9% respectively. By cooperating with Urumqi Boda Institute of Biotechnology, a formula of effective fertilizer of trace elements has been formulated, the fertilizer has been produced in batches and spread in Altay Prefecture, and an obvious yield-increasing result has been achieved.

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第一篇　中低产田的形成条件及分区与评价

第一章　中低产田的形成条件

中低产田是指区域农作物产量较低的耕地。农作物品种的多样化和产量的不断提高，是人类社会发展的基础和科学技术进步的体现。由于自然地理条件的差异，地球上不同的自然地理带，农作物的品种和产量差异很大；农作物是人类耕作劳动的产物，在同样的自然条件下，不同的国家和民族，由于科学技术、农业管理水平的差异，以及宗教、文化传统等因素的影响，同一种农作物产量差异也较大；即使在自然条件相似，社会经济文化状况相近的同一村落，由于不同的劳动者对土地的劳动、物质投入以及经营管理不同，农作物的产量也有较大的差异。总之，耕地农作物产量的高低，是由两个主要方面决定的，一个是与农作物生长有关的自然条件，包括地貌、气候、水文、土壤等因素；另一方面是农业生产过程，包括农业基础设施、田间管理水平、对耕地的劳动和物质投入等。

第一节　自 然 条 件

一、地貌

阿勒泰地区跨阿尔泰山、准噶尔盆地、萨吾尔山等三大地貌单元，农业地貌类型多样。耕地分布区的农业地貌特征如下：

1. 山地

阿尔泰山受纵向断裂构造控制，从东北向西南显示出递级阶梯，层状地貌清晰，在海拔1 100～1 500 m的阶梯面上分布有旱地或水浇地。萨吾尔山为断块山地，北缓南陡，北坡海拔1 500 m以下的低山丘陵区，可见旱地或水浇地。耕地坡度一般为3°～15°，也可见＞15°的陡坡地。山地地表组成物质以残积物为主，土层一般厚30～50 cm，有的下伏花岗岩体，土层含碎石较多。黄土覆盖区与地势低洼地方的土层较厚，多为细土层。山区耕地水土流失明显，尤以水浇地侵蚀最为强烈。

2. 山间盆地和谷地

因山体断裂形成，诸如铁列克、海流滩、冲乎尔、可可托海、吐尔洪、青河等山间盆地。哈巴河、布尔津河、克兰河、大小青河等河流的部分河段河谷开阔，阶地发育。山间盆地和谷地地势平坦，土层厚，灌排方便，光热充足，是农业生产的优良场地，为高产耕地分布的主要区域。

3. 平原

(1)冲洪积倾斜平原：位于额尔齐斯河以北的阿尔泰山前和萨吾山北麓，耕地分布广泛。

阿尔泰山前冲洪积平原海拔420～700 m，土层一般0.3～1.0 m，下伏基岩为第三纪泥岩和少量花岗岩。其中哈巴河与布尔津河冲积扇海拔420～600 m，坡度＜1°，土层厚1 m左右，以砂质细土物质为主，下覆砂卵石层。土质中的细土物质自上而下逐渐变细，至扇缘粘土含量增加，土质变细，土壤盐渍化加重。萨吾尔山北麓冲洪积倾斜平原，海拔780～1 200 m，坡降为16.9%～22.9%，组成物质以砂砾质土为主，拉斯特乡北部土层约0.3 m，下覆第三纪泥岩。水浇地冲刷强烈，水土流失严重。

(2)山麓洪积平原：主要见于阿尔泰山东段山麓地带及萨吾尔山北麓。由暴雨洪水携带物堆积形成，可见大小不等的洪积扇，地势略有起伏，坡度≤7°，土层厚0.35～1.0 m不等，组成物质多砂砾及棱角碎石，洪积扇中、下部分布有少量耕地。

(3)河谷平原：主要分布于额尔齐斯河、乌伦古河、克兰河、青格里河和布尔根河等河谷内。由河漫滩、河流阶地组成。位于阿勒泰境内的额尔齐斯河、克兰河河谷平原地势平坦，土质优良，水源便利，种植业发展条件优良。乌伦古河平原地表切割微弱，土层厚0.6～1.5 m，其下为砂砾石层及第三纪泥岩地层。青格里河和布尔根河土质良好，水源便利，耕地质量较好。

(4)额尔齐斯河与乌伦古河之间平原：东邻石质准平原，西抵布伦托海，海拔464～750 m，地势由东南向西北倾斜，坡降1.6%～4.4%，地势起伏不大，可见一些浅洼地。干燥剥蚀与风蚀作用强烈。土层厚30～65 cm，下伏第三纪不透水泥岩层，耕地易发生沼泽、盐渍化。

乌伦古河三角洲具有地形平坦，土层深厚，地下水位高，排水较困难等特点，耕地易发生沼泽化和盐渍化。

4. 沙漠

分布于平原区，主要有新月形沙丘、沙垄、平沙地等类型。耕地主要位于平沙地。由于区内风力强劲，风沙活跃，沙化严重。

二、气候

阿勒泰地区纬度偏高，深居内陆，远离海洋，多在大陆性气团控制下，是冷空气入侵新疆的主要通道之一，气温变化剧烈，降水少变率大，蒸发强，具有明显的温带大陆性气候特征①。

1. 气温

阿勒泰地区少酷暑，多严寒，常年气温不高。区内气温平原与山区有所不同。①平原区年均气温为4 ℃左右，≥10 ℃积温在2 200～3 000 ℃，无霜期128～160天，4～9月各月平均日较差在11.5～17.2 ℃，有利于植物体内有机物质的积累；②山区年均温－2～－4 ℃，无霜期和活动积温等热量条件均低于平原区，植物生长期短，适于喜凉植物生育。

2. 降水

区内降水主要来自西风气流所含水汽，降水分布西部多于东部，山区多于平原。山区年降水量为200～600 mm，平原区仅100～200 mm。夏季降水量占全年降水总量的60%。山区旱地农作物依赖降水，水浇地为灌溉农业。

① 阿勒泰地区农业区划办公室，阿勒泰地区农业区划报告，1987年。

3. **大风**

阿勒泰地区是新疆主要的寒潮大风区。在地区七县市中，吉木乃、哈巴河、福海、富蕴、青河的年均风日数分别为63.2、62.0、43.5、25.1和7.7天。哈巴河、吉木乃最多年份分别达102天和82天。大风以春季和夏初出现频率最高。寒潮大风酿成农作物冻害，并风蚀土壤。此外，每年7～8月在山前平原持续出现2～3天的干热风，造成小麦减产。

三、土壤

地区共有16个土类，19个亚类。农区耕作土壤主要有灌耕栗钙土、灌耕棕钙土、潮土、灌耕草甸土、盐化灌耕龟裂土、旱作黑钙土等6类。大部分土壤具有土层薄、质地粗、含砾石多、透水性强、下伏有第三纪泥岩不透水层，土壤易下潮及盐碱化等特点。

土壤有机质含量普遍较低，缺氮少磷，部分地方钾不足，锌、钼、硼、锰和铁等微量元素缺乏。

四、水资源

阿勒泰地区有额尔齐斯河、乌伦古河和吉木乃山溪等3大水系。分布有大小河流65条和千余眼山泉。年总径流量124×10^8 m^3。地表水资源丰富，水质较好，矿化度在0.1～0.2 g/L。河流出山口后，随着降水量减少，蒸发量增大及人类活动频繁，水质矿化度也增高。地下水资源可开采量为7.9×10^8 m^3/a，目前实际开采量为0.22×10^8 m^3/a，开发潜力大。

区内水资源时空分布不均，河流径流的年际变化大，年较差系数Cv值在0.3～0.5。年内5～7月份的地表水占年总量的61%～72%，其中6月份占年总量的29%～34%。水资源在空间分布上具有西多东少，北多南少的特点。水土资源地域组合不平衡，以额尔齐斯河为界，其南、北的水土比分别为1:6.7与9:3.3。因此，额尔齐斯河以北水多而沼泽地发育，以南则干旱缺水。

第二节　社会、经济状况

阿勒泰地区隶属于伊犁哈萨克自治州，有七县(市)50个乡(镇)。1997年人口为57.465 8×10^4人。国内生产总值247 466.98×10^4元(当年价，下同)，其中农业增加值70 059.91×10^4元，农业人口人均2 028.3元。

1997年，全区耕地面积136 351.6 hm^2，农作物播种面积为99 430 hm^2，其中粮食作物53 790 hm^2，粮食总产218 634 t，平均单产4 065 kg/hm^2，人均占有粮食380.5 kg，低于自治区人均480.7 kg平均水平。苜蓿播种面积36 060 hm^2，总产166 860 t，单产4 627 kg/hm^2。年末牲畜存栏数496.22×10^4头(标准羊)。地区有大中型拖拉机1 734台，小型拖拉机4 562台。大中型机引农具3 048台，小型机引农具2 792台。农作排灌动力机械995台，农用水泵826台，联合收割机307台，农用载重汽车724辆，农业机械总动力22 417.8 kW，综合机械化作业率为47.94%。拥有水库44座，总库容6.7153×10^8 m^3。灌溉渠道长16 297.7 km，其中干、支渠系长5 477.5 km，排渠4 828.7 km。可用机井832眼。地膜覆