COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

CHINA

中国粮食和农业植物遗传

资源状况报告

State of Plant Genetic Resources for Food and Agriculture in China

（1996-2007）

中华人民共和国农业部

The Ministry of Agriculture, People’s Republic of China

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序

1996 年受农业部委托，中国农业科学院原作物品种资源研究所组织专家完成了第一份《中国粮食和农业植物遗传资源状况报告》，为《世界粮食和农业植物遗传资源状况报告》提供了重要素材，受到联合国粮农组织（FAO）的较高评价。《世界粮食和农业植物遗传资源状况报告》于 1996 年在德国莱比锡召开的第四届世界植物遗传资源技术大会上予以通过。并在此次会议上，形成和通过了《粮食和农业植物遗传资源全球行动计划（GPA）》，提出了关于保护和可持续利用植物遗传资源的 20 项优先行动，并鼓励世界各国通过国家行为和国际合作全面实施，促进世界粮食和农业植物遗传资源的安全保护和可持续利用，为解决世界粮食和贫困问题做出贡献。

中国拥有丰富的粮食和农业植物遗传资源，十多年来为有效实施《粮食和农业植物遗传资源全球行动计划》采取了一系列切实有效的措施，取得了良好进展，对中国和世界植物育种和粮食安全做出了突出贡献。为全面总结在植物遗传资源保护和可持续利用方面取得的新成绩，并对面临的挑战和需求进行分析评估，中国农业科学院作物科学研究所组织有关专家完成了第二份《中国粮食和农业植物遗传资源状况报告》，为 FAO 的第二份《世界粮食和农业植物遗传资源状况报告》提供信息。

第二份《中国粮食和农业植物遗传资源状况报告》是应联合国粮农组织的要求，并依照“国家报告撰写指南”编写的，得到了联合国粮农组织的资助。农业部高度重视国家报告的编写工作，成立了领导小组和专家咨询委员会，并委托中国农业科学院作物科学研究所组织有关专家，在广泛调研、收集资料、科学分析、归纳总结的基础上，形成了正式报告。

第二份《中国粮食和农业植物遗传资源状况报告》由摘要、引言和正文构成。该报告全面反映了中国十年来在粮食和农业植物遗传资源安全保护和可持续利用方面的新进展，提出了未来发展的新需求，对促进《粮食和农业植物遗传资源全球行动计划》在中国的更好实施，解决国家乃至世界粮食安全和农业可持续发展具有指导意义。

2008 年 6 月
北　京

摘 要

十多年来，中国政府十分重视粮食和农业植物遗传资源的保护和可持续利用，并根据《粮食和农业植物遗传资源全球行动计划》20 项优先领域，通过制定和完善相关的法律法规，加强了粮食和农业植物遗传资源的管理；通过培训和科普宣传，提高了公众意识；通过国际合作和协作网建设，实现了信息、人员和植物遗传资源的交流与交换；通过国家计划和项目，建立和完善了植物遗传资源保护体系，实现了植物遗传资源的安全保存和可持续利用，为中国乃至世界植物育种和粮食安全发挥了较大作用。

1．对主要粮食和农业植物野生种进行了系统调查和编目，建立了 86 个原生境保护点，包括野生稻、野生大豆、小麦野生近缘植物、野生蔬菜等，另外 30 个原生境保护点已列入计划待建，有效遏制了野生植物遗传资源的快速灭绝现象。

2．建成和完善了 1 座国家长期库、1 座国家复份库、10 座国家中期库、29 座省级中期库、32 个国家种质资源圃（含 2 个试管苗库），另外 7 个种质圃正在建设中。基本形成了较为完善的国家植物遗传资源保护体系，长期保存植物遗传资源 391,919 份，比 1996 年增加 32,956 份。

3．繁殖更新了 286,604 份植物遗传资源，充实了中期库，极大地提高了植物遗传资源分发和供种能力。仅 2001-2007 年就向全国 2650 个单位，提供了 13.2 万份次植物遗传资源。

4．国家投资 1.8 亿元人民币，于 2003 年建成了“作物基因资源与基因改良国家重大科学工程”，为植物遗传资源的基因型鉴定、发掘具有重大应用前景的新基因提供了条件平台。

5．通过植物遗传资源的深入鉴定与评价，创造了一大批优异种质，培育了大量植物新品种并应用于生产，提高了植物遗传资源的利用率。同时，中国政府十分重视植物遗传资源的多样性利用，通过不同作物间作套种、同一作物不同品种混合种植，保护了品种的多样性，减少了病虫杂草危害。

6．通过加强植物遗传资源的管理，实现了国内植物遗传资源的共享，扩大了对外交流与交换，为中国乃至世界粮食安全、国民经济又快又好发展、减少贫

困、增加农民收入做出了较大贡献。

尽管中国在粮食和农业植物遗传资源保护和利用方面取得了显著成绩，但还面临许多挑战。需要加强与其他国家和国际组织的合作，获得国外植物遗传资源和相关技术；继续进行植物遗传资源，特别是野生植物遗传资源、边远地区古老农家品种的调查、考察与收集，进一步建设和完善植物遗传资源保护体系，实现本国植物遗传资源的全面保护；系统深入地鉴定评价已保存的植物遗传资源，提供育种家利用，拓宽育种材料的遗传基础；实现更加充分的资源共享和利益分享，进一步提高资源利用效率。

引 言

中华人民共和国（简称中国）位于亚洲的东部，东面与朝鲜接壤，南面与越南、老挝、缅甸接壤，西南面和西面与印度、不丹、尼泊尔、巴基斯坦和阿富汗接壤，西北面和东北面与俄罗斯、哈萨克斯坦、吉尔吉斯斯坦、塔吉克斯坦接壤，北面是蒙古国。是日本、菲律宾、马来西亚、印度尼西亚、文莱等国家和地区的近邻。中国拥有 960 万平方千米的国土面积，是亚洲面积最大的国家。

中国地形多种多样，西高东低，其中山地占国土面积的 33%，高原占 26%，盆地占 19%，平原占 12%，丘陵占 10%。主要河流有长江、黄河、珠江、黑龙江、淮河和海河等，这些江河都流入太平洋。中国疆域辽阔，地跨热带、亚热带、温带和寒带。大部分地区位于北温带和亚热带，属东亚季风型气候。由于地形复杂，海拔高度差异大以及腹地与海洋之间的距离远，拥有复杂多样的气候类型。各地区间的年降水量有很大的差异，由东南沿海到内陆降水量逐渐减少，东南沿海地区年降水量超过 1500 毫米，西北某些地区的年降水量低于 50 毫米。

中国是一个人口众多的国家。2005 年 1 月，除台湾、香港和澳门，大陆人口总数达 13 亿，居世界第一位，约占世界总人口的 22%。中国人口主要集中在东部地区和中部地区，西部地区人口相对较少。

中国耕地面积约 1.2 亿公顷，农作物播种面积约 1.5 亿公顷，其中粮食作物播种面积约 1.0 亿公顷，2007 年的粮食总产量为 50150 万吨。中国是世界上实行间套作及复种面积最多的国家，复种指数约 160%。在长江中下游一带有水稻～小麦两熟，双季稻与油菜三熟轮作等。长江以北至黄河下游一带，则是中国冬小麦、棉花、玉米、花生、大豆的集中产区，多实行一年二熟或两年三熟的种植制度，间套作方式主要有小麦、马铃薯间套种玉米，花生间作芝麻，高粱间作黑豆等。十多年来，设施栽培在中国发展很快，实现了蔬菜一年多熟。

中国农作物的分布具有明显的地域性。东北地区是玉米、大豆、水稻、高粱、甜菜的集中产区，一年一熟。西北地区处于干旱、半干旱地带，主要作物有春小麦、玉米、谷子、青稞、马铃薯、瓜果等，一年一熟。华北平原地区，是小麦、

玉米、大豆等作物的主要产区，一年两熟或二年三熟。长江中下游地区，是水稻、棉花、油菜、蚕丝、茶叶的主要集中产区。广东、广西、海南、福建及云南部分地区属亚热带及热带，农作物一年可三熟，盛产水稻、甘蔗、橡胶、咖啡、椰子、油棕以及热带水果等。

中国农业发展很快，主要依靠国家支农惠农政策、增加农田基本建设投入和科技进步等。加强植物遗传资源保护与利用，培育高产、优质、抗病、高效利用水肥的新品种，对持续提高农作物单产和总产量，确保粮食安全发挥着重要作用。

农业部是国家主管农业的政府机构，省级农业厅、县级农业局是地方政府农业管理机构。植物遗传资源属于国家所有，隶属农业部管理。中国农业科学院、中国热带作物科学院、中国水产科学院是国家级农业科研单位，各省、各地区还设有农业科学院或农业科学研究所。中国农业科学院作物科学研究所受农业部委托，具体负责中国粮食和农业植物遗传资源的考察收集、引进交换、鉴定评价、安全保存、分发利用等方面的组织、协调、管理和实施。

中国农作物新品种的培育主要由农业科研院（校）和种子公司完成，育成的主要农作物新品种必须通过国家或省级品种审定委员会的审定，并在规定的区域范围内推广种植。育成品种可以申请植物新品种保护，体现知识产权。农作物新品种的管理由农业部以及各省（市）种子管理站负责，种业企业具体进行种子的生产和经营。

第一章 多样性现状

中国地域辽阔，农区地势复杂，平原、丘陵、山地、高原、河谷、盆地交错分布，土壤类型多种多样，海拔高度差异显著，局部地区有“立体农业”特点；气候多样，有寒带、温带、亚热带和热带，有湿润区、半湿润区、半干旱区和干旱区。中国农业历史悠久，勤劳的中国人民驯化和栽培了大量的粮食和农业植物，使中国成为世界栽培植物重要起源中心之一。同时，在不同的生态环境条件下，经过长期的自然选择和人工选择，又形成了各种各样的地方品种，培育了类型多样的现代品种。在物种和品种水平上构成了丰富多彩的粮食和农业植物遗传资源。

1.1 中国作物物种多样性概况

据初步统计，在中国与农业和人类生活密切相关的物种有10000个左右。目前，中国的栽培作物有661种（林木未计在内），其中粮食作物35种，经济作物74种，果树作物64种，蔬菜作物163种，饲草与绿肥78种，观赏植物（花卉）114种，药用植物133种。这些栽培作物共涉及分类学上1356个栽培物种、2172个野生近缘种，其中粮食作物涉及103个栽培物种，311个野生近缘种；经济作物涉及98个栽培物种，454个野生近缘种；果树作物涉及149个栽培物种，420个野生近缘种；蔬菜作物涉及222个栽培物种，150个野生近缘种；饲草与绿肥涉及196个栽培物种，353个野生近缘种；观赏植物涉及588个栽培物种，484个野生近缘种。

关于起源或原产于中国的栽培植物，中外科学家进行了广泛考察和考证，普遍认为约有300种作物起源于中国。

1.2 主要作物多样性现状

总体来看，50多年来，中国的主要作物种类没有发生太大变化。中国种植的作物长期以粮食作物为主。20世纪80年代以后，由于推行农业结构调整政策，经济作物和园艺作物种植面积和产量有所增加。

中国的粮食作物主要包括禾谷类作物、豆类作物、薯类作物等，其中禾谷类作物占84.3%。水稻、玉米和小麦是中国最主要的作物，2006年的栽培面积分别

占禾谷类作物的35.0%、32.3%和27.9%，是影响中国粮食安全和社会经济最重要的三大作物。水稻主要种植于中国南方广大地区和东北部分地区，玉米主要种植于从东北到西南的狭长地带，而小麦则主要种植于中国黄淮海地区。玉米是粮饲兼用作物，近年来发展很快，其总产量已超过小麦而居第二位。在食用豆类作物中，主要种植于东北、西北和西南地区的普通菜豆和主要种植于西北、西南和江浙一带的蚕豆是中国栽培面积超过100万公顷的两种食用豆类作物。马铃薯和甘薯是栽培面积分别名列所有作物第七位和第九位的薯类作物。在中国，马铃薯主要种植于北方地区，甘薯则主要种植于南方地区；马铃薯主要用作蔬菜，甘薯主要用作饲料，这两种作物在一些地区亦当作粮食。

经济作物包括油料作物、糖料作物、纤维作物、嗜好作物等。种植于东北和黄淮海地区的大豆和种植于南方的油菜等，是栽培面积上仅次于水稻、玉米和小麦的两大油料作物；另外，花生也是我国种植面积较大的油料作物，其栽培面积在所有作物中位居第八。栽培面积位于第六位的是棉花主要种植于黄淮海、长江流域和新疆地区，中国93％的天然纤维来自棉花。栽培面积超过100万公顷的经济作物还包括烟草、甘蔗、茶和向日葵。主要种植于中国热带地区的甘蔗栽培面积占糖料作物的88.5％。种植于南方的烟草和茶树也是中国主要的经济作物。向日葵分布广泛，主要有油用和食用两类。

园艺作物种类繁多，虽然种植面积较粮食作物小，但产值较高，在调整产业结构和改善膳食结构中占有重要地位。在种植面积超过100万公顷的果树作物中，在南方广泛种植的柑橘排名第一，并且也是所有作物中排名第十的重要作物，包括柑、橘、橙、柚、金橘、柠檬等种类。其次是主要种植于北方的苹果、李和梨。在种植面积超过100万公顷的蔬菜作物中，全国广泛栽培的大白菜排名第一，西瓜排名第二，其次是萝卜、黄瓜、甘蓝、番茄、茄子、芦笋等。

对于上述主要作物，品种改良工作不断加强，新育成品种的产量高、适应性广，因此，在相当长的历史时期内，生产上种植的品种数量总体呈现明显的下降趋势，并且少数品种占据了相当大的栽培面积。例如，20世纪40年代中国种植的水稻品种有46000多个，现在种植的不到1000个，其中面积在1万公顷以上的只有300个左右，而且半数以上是杂交稻；20世纪40年代中国种植的小麦品种有13000多个，其中80％以上是地方品种，而20世纪末种植的品种只有500～600个，其中

90％以上是选育品种。

需要注意的是，在过去的十多年中，由于受市场需求、饮食文化、生活水平提高等外部环境变化因素的影响，有些作物的重要性也发生了变化。例如，玉米以前是中国的第三大作物，目前已成为第二大作物，因为随着人民生活水平的提高，肉奶需求量急剧增加，玉米成为了最重要的饲料作物。

1.3 次要作物和未充分利用作物多样性现状

粮食作物中的次要作物和未充分利用作物包括谷子（主要种植于北方部分省区）、黍稷（主要种植于北方）、大麦（主要种植于西北、西南等地）、荞麦（主要种植于山西和西南地区）、燕麦、小黑麦、黑麦、绿豆、豌豆、小扁豆等。谷子在中国曾是北方地区的主要粮食作物之一，尤其在20世纪50年代以前，在北方粮食作物中占据十分重要的地位，但目前已成为边远旱地作物，面积降至100万公顷以下。荞麦在中国分布很广，由于生育期短，多作为备荒、填闲作物。中国豆类作物较多，豌豆、绿豆、小豆种植历史悠久，分布很广；豇豆、小扁豆、饭豆种植历史也在千年以上。木薯主要种植于中国南方热带地区，作为一种重要的能源作物，近年来在海南和广西、广东发展较快。

经济作物中的次要作物包括油料作物芝麻、油用亚麻、蓖麻和红花，糖料作物甜菜，嗜好作物咖啡，工业原料作物高粱、啤酒花和橡胶等。高粱在20世纪50年代以前曾是东北地区和华北地区的主要粮食作物之一，现已逐渐成为酿酒工业原料，面积大大缩减。麻类作物在中国是次要的和未充分利用的作物，苎麻历来是衣着和布匹原料；黄麻、红麻、青麻、大麻、剑麻、亚麻是绳索和袋类原料。种植于东北地区的甜菜是较为重要的糖料作物，种植于南方的桑是古老作物，咖啡是海南省的重要饮料作物。

蔬菜作物中的次要作物包括绿叶蔬菜，如芹菜、菠菜、莴苣、苋菜、蕹菜、茼蒿、落葵等；瓜果类蔬菜，如辣椒、甜瓜、南瓜、西葫芦、冬瓜、丝瓜、瓠瓜、苦瓜等；豆类蔬菜，如菜豆、长豇豆、扁豆、刀豆等；芥菜、芜菁、不结球白菜、青花菜、芥兰等属于次要蔬菜，但种植范围广泛；块根块茎蔬菜作物中包括生姜、山药、魔芋、菊芋等，生姜是重要的调味蔬菜，也是中国出口蔬菜的拳头产品，魔芋是重要的淀粉兼蔬菜作物；香料和调味蔬菜，如葱、姜、蒜、茴香、花椒、八角等；多年生蔬菜，如黄花菜、百合、枸杞、芦笋、竹笋等；根菜类蔬菜胡萝

卜和水生蔬菜，如莲藕、茭白、荸荠、慈姑、菱、芡实、莼菜等也是不可或缺的次要蔬菜。上述次要蔬菜虽然种植面积较小，但种植范围广，是餐桌上不可缺少的蔬菜。

栽培面积不超过100万公顷的果树作物包括柿、桃（含油桃）、葡萄、芒果、香蕉、核桃、栗子、菠萝、槟榔、油棕、椰子、杏、枣、木瓜、樱桃、无花果、草莓、橄榄等。在北方桃、杏的种类极多；山楂、枣、猕猴桃在中国分布很广，野生种多；草莓、葡萄、柿、石榴也是常见水果。香蕉种类多，生产量大；荔枝、龙眼、枇杷、梅、杨梅为中国原产；椰子、菠萝、木瓜、芒果等在海南等地和台湾普遍种植。干果中核桃、板栗、榛也广泛种植于山区。

1.4 野生近缘种多样性现状

中国是世界八大作物起源中心之一，其粮食与农业栽培植物不仅种类多，而且野生种和野生近缘植物也很多。据统计，已收集和保存的农业野生植物遗传资源约35000份，其中粮食作物野生近缘种资源20000余份，油料野生近缘种资源9700余份，果树、桑树和茶树野生近缘种资源3000余份，麻类、甘蔗和牧草等野生近缘种资源2300份左右。

粮食作物的野生近缘种有野生稻(普通、疣粒、药用野生稻、假稻等)，小麦近缘野生植物有山羊草、鹅观草、披碱草、赖草、冰草等11个属，野生大麦有二棱（*Hordeum vulgare* ssp. *spontaneum*）和六棱(*H. vulgare* ssp. *agricrithon*)两种，谷子野生近缘植物狗尾草，多年生野生甜荞和苦荞、一年生野生甜荞和苦荞，野黍，还有野豇豆、野小豆、野绿豆等。

油料作物有野生大豆、野油菜、野油芥、野苏子等。野生大豆发现有3个种，即一年生种*Glycine soja*、多年生种*G. tabacina*和*G. tomentella*。纤维作物有野苎麻8种，包括白叶种苎麻、绿叶种苎麻、悬铃叶苎麻等，野黄麻有长果种、圆果种和假黄麻，野生大麻，野青麻，野生亚麻有宿根亚麻、垂果亚麻、野生亚麻等。甘蔗野生近缘植物有割手密、斑茅、河八王和金猫尾等。茶树共有37个种，其中仅有三分之一的物种驯化成栽培品种。桑树有15个种，其中11个种是野生桑。啤酒花有1个野生变种，在新疆的天山、阿尔泰山山脉均有广泛分布。

栽培蔬菜的野生种和野生近缘植物有，韭菜野生种卵叶韭、太白韭、粗根韭、青甘韭、蒙古韭、山韭、疏花韭、玉簪叶韭、野韭等；野生葱有阿尔泰韭、实葶

葱、野葱等；大蒜的野生近缘种有野生大蒜、小山蒜、新疆蒜、星花蒜、多籽蒜；黄瓜近缘种酸黄瓜；辣椒近缘种大树椒、云南涮辣椒；水生蔬菜野生种有野水芹、野菱、野荸荠、野慈菇、野薄荷等。其他野生蔬菜种类也很多，正在研究和开发利用的野菜达500多种，如山胡萝卜、高河菜、沙芥、诸葛菜、荠菜、小米辣、野茄、毛酸浆、马齿苋、豆腐柴、藜、东风菜、蒲公英、车前草、刺芫荽等。

中国的野生果树资源更为丰富，苹果属野生种有山荆子、楸子、新疆野海棠、湖北海棠、河南海棠、新疆野苹果；梨的野生种有杜梨、褐梨、豆梨、秋子梨；山楂野生种已收集保存12个种，多数处于未开发利用状态；桃野生种有山桃、甘肃桃和光核桃；枣的野生种有10种，野酸枣遍布华北各地，葡萄野生种20多个，柿树有50多个野生种，猕猴桃有57个野生种，新疆和西藏都有野生核桃；另外，杏、樱桃、板栗、榛、柑桔、荔枝、枇杷、龙眼都有野生种。

然而，中国野生近缘种遗传资源损失比较严重，例如，云南景洪县原有野生稻生态点24处，2001年时仅剩1处；普通野生稻在江西东乡原有9个居群，尽管采取了一些人工保护措施，但2001年时仅剩2个居群。2001年以来，国家建立了一系列原生境保护点，加强了野生种质资源保护，从一定程度上缓解了野生近缘种濒危的局面。

1.5 作物品种的多样性现状

在类型和品种多样性水平上，中国已收集的作物遗传资源以地方品种为主，约占85%。但是各种作物差别较大，一般来说主要作物的地方品种所占比例相对比次要作物的少，这是因为大宗作物育种历史悠久，育成了大批优良品种(系)，而食用豆类、燕麦、荞麦、芝麻、小白菜、萝卜、茶、桑和多种果树的遗传资源则以地方品种为主。正因为如此，大宗作物在生产上利用的品种几乎都是育成品种；而小宗作物的地方品种仍在生产上种植，但随着小宗作物育种的不断发展，有的正在被育成品种或杂交品种所替代。

水稻品种主要有粳稻与籼稻、水稻与陆稻、早稻、中稻与晚稻、粘稻与糯稻之分，在籼、粳两个亚种下可分为50个变种和962个变型。中国的普通小麦类型非常多，共有127个变种，居世界第三位。中国的玉米品种可划为5个种族，即北方马齿种族、硬粒和马齿种族间杂交的衍生种族、北方八行硬粒种族、宽扁穗玉米种族和南方糯玉米种族。中国的栽培大豆品种可划分为7个型480个群，根据播

种期可分为北方春大豆、黄淮夏大豆、黄淮春大豆、长江夏大豆、长江春大豆、南方春大豆、南方秋大豆和南方冬大豆。

地方品种在生产上利用的一个特点是，边远山区种植的较多，不但种植品种数目多，且作物的种类亦多。地方品种仍被农民保留种植的主要原因是：第一，育成品种不能适应当地生态区，特别是气候冷凉、干旱或水涝和盐碱、贫瘠及酸性土壤地区；第二，一些地方品种具有良好的抗逆性或抗病性或品质较好，还有的地方品种有着特殊的利用价值，如紫糯稻有药理作用。

生产上种植的地方品种，在当地粮食供应中发挥着重要作用。例如，水稻地方品种黑糯谷仍在云南部分地区种植；地方品种香稻香气浓馥，品种有云南香米、贵州香禾、洋县香米等；黑米和紫米稻类，米粒表面黑色、紫色或褐色，有滋补强身作用，品种有云南紫米、广西东兰墨米、贵州黑糯米、鸭血糯等；云南省特有的软米，其米质介于糯米和粘米之间，米饭软甘甜爽口；胭脂稻在河北已有200多年的栽培历史；传统优质稻如水葡萄、八宝、丝苗等品种因品质优良，仍在山东、安徽、河南、湖北、广东、云南、江苏等地种植。玉米的地方品种主要在生产水平较低的边远山区种植，其主要特点是抗冷、抗旱、早熟，如血玉米、二黄包谷、小黄包谷、白团颗、二季早、六十日等等。红苞谷目前仍在云南种植，主要用于酿酒。此外，中国特有的玉米遗传资源是广泛种植于西南各省区的糯玉米，中国现保存糯玉米地方品种1300多份，主要品种有腾冲糯包谷、新平白糯、宜山糯、花丝糯、岭巩白糯、平利糯玉米等，一穗只有4行的四路糯玉米仍在云南部分地区种植。另外，有些作物的推广品种中，仍以地方品种为主，如食用豆类、黍稷、荞麦。大麦地方品种黑青稞等仍然广泛种植于云南和西藏高山地区。

经济作物中的地方品种在生产上保留的更多。白菜型油菜和芥菜型油菜的地方品种非常丰富，它们具有高度的地区适应性，西部高原的代表品种有门源油菜、伊梨黄油菜、小日期、临潭大黄芥。苎麻主栽品种多数是地方品种，如黑皮兜、芦竹青、细叶绿；青麻有大青秆、赞天灰、安新、二伏旱；大麻有华亭大麻、五常40号等等。此外，茶、桑树地方品种在生产上还在利用。

蔬菜地方品种非常丰富，目前仍然有许多大宗蔬菜的地方品种在生产中栽种，如菜用大豆地方品种黄籽豆、五月半；小白菜地方品种上海四月慢、南京矮脚黄、南通马耳朵、乌塌菜、舟山黑油筒；萝卜地方品种心里美、大红袍、涪陵

红心萝卜、潍县青萝卜、八里桥绿萝卜；茄子地方品种荣昌乌棒茄、大民茄、青翠小茄子、糙青茄、绿皮长茄、十姐妹茄、六叶茄、七叶茄、高秆竹丝茄和墨茄等；辣椒地方品种干红辣椒、云南小米辣、织金辣椒、绥阳朝天椒、余干辣椒、丘北辣椒等；瓜类蔬菜地方品种板桥白黄瓜、五叶香丝瓜、孝感瓠子、白玉霜丝瓜、株洲长白苦瓜等。其他小宗蔬菜的地方品种在生产中利用的更多，特别是无性繁殖和多年生蔬菜的主栽品种几乎都是地方品种。葱蒜类地方品种，如赤水孤葱、娜姑弯葱、漳州大葱、毕节大蒜、乐都紫皮蒜、邳州白蒜、阿城大蒜、开原大蒜、蔡家坡大蒜、白马牙大蒜、拉萨白皮大蒜、温江红七星、二水早等；韭菜地方品种，如寿光独根红、汉中冬韭、云南苤菜等；山药地方品种，如江苏射阳怀山药、昆明淮山药、禄丰脚板山药、兖州黄牛腿山药、双胞山药等；黄花菜地方品种，淮阳黄花菜、渠县花等；百合地方品种，如太湖百合、兰州百合、龙芽百合等。

中国栽培的果树种类约140种，目前以地方品种为主的是梨、山楂、杏（如软条京杏、硬条京杏、哈密杏）、板栗、银杏、枣（如保德油枣、雅枣）、榛、核桃、荔枝、龙眼和枇杷等。著名的梨地方品种有花盖梨、苹果梨、脆香蜜梨、砀山酥梨、鸭梨、金花梨、雪花梨等，桃的地方品种如白花、奉化玉露、深州蜜桃、中华寿桃和肥城桃等，枣的品种有梨枣和金丝小枣等，苹果地方品种胎里红苹果等。

1.6 影响多样性的主要因素

迄今为止，中国也发现了因为农民种植品种的多样性丢失导致遗传脆弱性威胁的案例。例如，20世纪60年代中期至70年代中期, 选育推广的第一、第二代玉米单交种如维尔156、丹玉1号等感染大、小斑病，导致了大斑病和小斑病流行；70年代中后期至80年代初期,第三代单交种中，以525为亲本的杂交种高度感染矮花叶病,导致矮花叶病迅速流行；80年代中后期的第四代单交种,以中单2号、丹玉13、烟单14为代表,其大面积推广致使青枯病和穗腐病愈加严重；90年代的第五代杂交种中，部分品种对灰斑病、弯孢叶斑病感病。小麦育成品种碧蚂一号在上世纪50-60年代大面积推广,导致了主要由1号条锈菌生理小种引起的条锈病大流行；60年代中期阿勃及相近血缘小麦品种的种植,促成了条锈菌18和19号生理小种流行；70年代小麦品种泰山一号在华北和西北地区的推广，哺育了24和25

号小种成为当时的优势生理小种,再次造成了较大区域小麦生产损失；洛夫林类血缘品种在80年代大范围种植,不但使28和29号生理小种急剧上升,品种抗锈性丧失,同时也使白粉病抗性丧失；90年代中期，繁62绵阳系列抗条锈病小麦的推广,却诱发了30和31号生理小种的流行。

据有关研究认为,现代育成品种的推广种植是导致品种多样性下降的主要原因，现代育成品种遗传基础狭窄，是导致遗传脆弱性的根本原因。例如，大面积推广种植的杂交稻，其不育系大多为野败型，恢复系则以IR系为主；占全国栽培面积60％左右的玉米杂交种仅含有6个骨干自交系（Mo17、黄早四、E28、自330、掖478和丹340）的血缘，若按自交系应用面积在10万公顷以上统计，也只涉及18个自交系；50％以上的小麦品种带有南大2419、阿勃、阿夫、欧柔4个品种的血缘；黄淮海地区221个大豆育成品种中, 137个(61.9%)来自于齐黄1号等4个系谱；在1376个陆地棉品种中，有1113个品种含有来源于美国和前苏联品种血缘的11个品种。另外，城镇化步伐加快、农业生产集约化、过度放牧、道路和大型水利工程建设等，也是导致作物品种多样性降低的重要原因。

1.7 需求评估与优先发展重点

1.7.1 加强农业栽培植物的起源与演化研究

深入研究中国栽培植物的起源与进化,尤其是对尚未明确的某些栽培植物起源问题进行系统研究，同时，研究建立不同栽培植物的品种分类体系，科学划分不同栽培植物的品种变异类型。

1.7.2 加强多样性和遗传侵蚀的评估与监测

优先对主要作物及其野生近缘种进行多样性现状评估,尤其是对生产上应用品种的多样性进行评估；加强对遗传侵蚀的监测，制定防止或减少遗传侵蚀的技术路线和实施措施。

1.7.3 加强多样性评估的条件建设

安排专项经费，建立遗传多样性评估实验室，研究建立遗传多样性评估标准和技术体系。

1.7.4 加强植物遗传资源的高效利用

深入挖掘地方品种和野生近缘种的优良特性和优异基因,拓宽育种材料的遗传基础，有效消除遗传侵蚀的负面作用。

第二章 原生境管理现状

自二十世纪下半叶开始，随着中国人口的增加和经济快速发展，为了满足日益增长的生存需求，扩大种植面积、改善种植条件、调整产业结构、提高作物产量等已成为农业发展的主要方式，随之也带来了栽培作物种类和数量急剧减少、作物品种渐趋单一、野生植物栖息地遭受严重破坏，植物遗传资源在自然界急剧下降。为了遏制植物遗传资源面临永久丧失的趋势，中国政府开展了植物遗传资源的抢救性收集和非原生境保存工作，取得了巨大成绩。虽然原生境保护工作开展得相对较晚，但近十年来也有了很大发展，原生境保护进入了一个快速发展时期。

2.1 调查与编目

2.1.1 农业野生近缘植物普查

2002 年至 2007 年，中国农业科学院作物科学研究所组织全国农业科研单位、大专院校和农业环保系统的专家对列入《国家重点保护野生植物名录》中农业野生近缘植物的 191 个植物物种进行了调查，在广泛搜集各物种已有的记载资料基础上，调查这些物种在各地的分布状况，以便掌握这些作物野生近缘植物地濒危状况。基本查清了这些物种的分布区域（到县级）、生态环境、植被状况、伴生植物、形态特征、保护价值、濒危状况等基本状况。经过整理和分析，编写了《国家重点保护农业野生植物要略》。

2.1.2 重要农业野生近缘植物调查

重要农业野生近缘植物调查的主要目标是调查各物种的种群分布状况，掌握各物种在遗传多样性水平的丰富度。经过 6 年的野外调查，基本掌握了野生稻 3 个种、野生大豆 3 个种、小麦野生近缘植物 87 个种、水生植物 8 个种、芸香科植物 8 个种以及冬虫夏草、蒙古口蘑、发菜等物种的资源现状。

野生稻调查涉及海南、广西、广东、云南、湖南、福建、江西等 7 个省 53 个县。调查结果表明，与 20 世纪 80 年代初相比，普通野生稻、药用野生稻和疣粒野生稻分布点大量丧失或面积急剧下降。同时，分别在云南、海南和广西发现 8 个疣粒野生稻和 35 个普通野生稻新分布点。一方面大量的野生稻资源遭受严重破坏，另一方面，由于交通条件改善，使得以前调查难以达到的极端偏远地区

的野生稻资源得以重新被发现。

野生大豆调查范围包括 15 个省 186 个县（市），调查原分布点 1200 多个，发现新分布点 200 多个和 2 个多年生野生大豆分布点。表明野生大豆在中国分布广泛，不仅存在一年生野生种，也存在多年生野生种，且一年生野生种能够在高纬度、高海拔等高寒地区正常生长。

小麦野生近缘植物调查主要在西北和西南 9 省区 133 个县（市）进行，调查小麦野生近缘植物 8 属 87 种 690 多个居群。发现了二倍体冰草（A. cristatum）、偃麦草（Et. repens）、赖草和大颖草等防沙、固沙、保护荒漠生态系统的重要物种。

此外，还对主要水体的水生植物、华中地区芸香科植物和麻类植物、长江流域茶树、华北和长江中下游果树、西北和西南地区的冬虫夏草、华北地区的发菜和内蒙古口蘑等濒危植物资源进行了调查。结果表明，拟纤维茨藻等水生植物在中国大陆可能已濒临灭绝，其他水生植物种群数量稀少，已处于濒危或灭绝状态。芸香科植物虽然分布范围没有明显变化，但种群显著变小，有些种群数量十分稀少，数量进一步减少的趋势没有得到有效缓解。冬虫夏草由于市场需求量极大，价格昂贵，致使人们过度采集，加之生态环境的恶化，产量逐年减少。冬虫夏草主产区的产量与 20 世纪 70 年代相比减少了 50%，个别地区减少达 70%以上。内蒙古口蘑由于气候变暖，降雨量减少，过度放牧，草场退化，过度采集等，生态环境受到严重破坏，自然产量日趋减少。发菜生于干旱和半干旱的草原地区，年降雨量在 80～250 毫米之间，由于过度采收、生态环境恶化、降雨量逐年减少，处于濒临灭绝状态。

2.2 保护区（点）内粮食与农业植物遗传资源的保护

2.2.1 自然保护区

截止2006年底，全国共建立各种类型、不同级别的自然保护区2395个，保护区总面积15153万公顷，陆地自然保护区面积约占国土面积的15.16%。与1993年相比，自然保护区数量分别增长近2倍，面积也增长1倍多。中国自然保护区分为自然生态系统、野生生物、自然遗迹保护区三大类，其中自然生态系统类自然保护区无论在数量上还是在面积上均占主导地位，分别占自然保护区总数和总面积的66.51%和68.41%。虽然在已建的自然保护区中保存着一定数量的植物遗传资

源，但以植物为主要保护对象的保护区相当少，其数量和面积仅分别占总数的6.6%和1.92%，并且其保护的植物中极少包含与粮食和农业相关的植物。

2.2.2 作物野生近缘植物原生境保护点

作物野生近缘植物大多分布于农、牧区，生态环境破坏严重，生境片断化致使作物野生近缘植物群落分布面积较小，不宜以保护区方式进行管理。为了保证作物野生近缘植物遗传资源不致在自然环境中消失，2001 年起，农业部开始进行作物野生近缘植物原生境保护点建设，确立了围栏、围墙、天然屏障、植物篱笆等几种适合中国国情的保护方式，制定了原生境保护点建设技术规范、管理技术规范和监测预警技术规范，从而使作物野生近缘植物原生境保护工作步入科学化、规范化和制度化的轨道。截止 2007 年底，全国 26 个省（市、自治区）共建成 86 个作物野生近缘植物原生境保护点，另有 30 个已列入计划待建。这些原生境保护点涉及野生稻、野生大豆、小麦野生近缘植物、野生莲、珊瑚菜、金荞麦、冬虫夏草、野生苹果、野生海棠、野生甘蔗、野生柑橘、苦丁茶、野生猕猴桃、中华水韭、野生茶、野生荔枝、野生枸杞、野生兰花等 26 类野生近缘植物。

2.3 保护区外农业生态系统保护

受经济、技术条件和认识水平限制，保护区外农业生态系统保护尚未纳入农业和粮食遗传资源保护的主体计划。近年来，随着全民对粮食和农业遗传资源保护意识的提高、经济条件的好转，中国政府启动了相应的工作。

2.3.1 采用与农业生产相结合的方式保护作物野生近缘植物

在全球环境基金（GEF）资助下，农业部启动了“作物野生近缘植物保护与可持续利用”项目，在全国8个省（自治区）选择8个野生稻、野生大豆和小麦野生近缘植物分布点作为示范点，借助国际组织的资金、技术和经验，通过消除代表中国不同社会经济状况的8个示范点对野生植物数量构成威胁的因素及其根源，更好地保护中国珍贵的作物野生近缘植物资源。其总体目标是在中国8个省的野生近缘植物主要分布区选择8个分布点，通过建立可持续激励机制、完善法律法规、提高地方政府和农民的保护意识与保护知识等措施，将野生近缘植物保护与农业生产相结合，使其成为农业生产活动的重要组成部分。

2.3.2 采用生态系统方式保护农业生物多样性

在欧盟（EU）和德国经济技术合作公司（GTZ）的支持下，农业部于2005年

启动了“中国南部山区农业生物多样性保护”项目，在海南、湖南、安徽、湖北、重庆等5省（市）选择14个县的28个村进行农业生物多样性保护的试点工作。其基本思路是：将农业生物多样性保护与农业生产相结合、与扶贫和改善农民生活质量相结合、与妇女、儿童教育相结合、与新农村建设相结合、与农田保护和土地整理项目相结合、与农村清洁工程相结合、与农村劳动力转移相结合，通过宣传、教育、培训和技术指导，使农民不再依赖于日益减少的农业生物多样性，从而达到保护的目的。目前该项目已完成前期调研和规划，并开始实施。

2.3.3 结合病虫害综合防治保护农作物地方品种

针对农业生物多样保护与利用、农业病虫害防治的需要，解决农业生物多样性应用技术中的重大科学问题，国家改革与发展委员会在云南农业大学，建立了第一个农业生物多样性应用技术国家工程研究中心。该研究中心通过建立品种优化搭配，优化群体种植模式的技术参数、技术标准和技术规程，建成10个万亩农业生物多样性应用技术示范点，不仅使示范区内病害防治效果达到70%以上，而且恢复使用和保护了230多个农作物地方品种。

2.4 农业与粮食植物遗传资源原生境保护存在的主要问题

（1）自然保护区建设主要侧重于生态系统和物种水平多样性的保护，忽视了遗传多样性水平的保护工作，保护区内被保护物种的遗传多样性丧失尚未纳入保护区管理的有关法律法规。

(2)作物野生近缘植物原生境保护点虽然在一定程度上缓解了野生近缘植物遗传资源的丧失，但目前原生境保护点主要以物理隔离方式进行保护，保护点建设后，仍存在着设施维护、后续管理和物种消长等负面因素的影响，可持续性较差；

（3）生态系统管理虽然具有可持续性，但中国人口众多，经济发展与遗传多样性保护的矛盾短期内难以达到协调和平衡，在全国更大范围开展植物遗传资源原生境保护还存在一些困难。

2.5 需求评估与优先发展重点

2.5.1 制定和完善相关法律法规和国家计划

建立和完善与《生物多样性公约》相适应的国家政策与法律法规体系；修订《中国生物多样性保护国家战略与行动计划》，将遗传多样性保护纳入国家和地

方国民经济与社会发展计划。

2.5.2 制定相关标准，建立预警系统

研究制定生物资源尤其是野生植物遗传资源的调查、数据采集和管理的国家标准；建立野生近缘植物原生境保护的监测预警系统，加强对已经建立的原生境保护点的管理和动态监测。

2.5.3 加强资金投入，确保原生境保护的可持续发展

加强国家专项资金投入和国际合作，继续进行野生植物遗传资源的调查、编目；建立新的原生境保护点；建立农民参与式的野生植物遗传资源保护体系，实现资源保护、开发利用和农民受益三者的统一。

第三章 非原生境管理现状

粮食与农业植物遗传资源收集、保存、鉴定、分发和利用活动主要是通过“国家粮食与农业植物遗传资源工作协作网”完成的。该协作网由牵头单位、核心单位及协作单位组成。牵头单位为中国农业科学院作物科学研究所，其主要职责是受农业部委托，负责全国粮食与农业植物遗传资源的收集、鉴定、评价、编目、引进、交换、保存、供种分发和设施建设等方面国家项目的规划与组织实施。核心单位包括中国农业科学院作物科学研究所、棉花研究所、油料作物研究所、蔬菜花卉研究所、草原研究所等 40 余个单位，主要负责某一种（类）植物遗传资源收集、鉴定、评价、编目、引进、中期保存、繁种更新、供种分发。协作单位包括各省（市）农业科学院、有关农业大学等，主要参与植物遗传资源某一项具体活动，如收集或鉴定评价等。

3.1 收集品现状

粮食和农业植物遗传资源必须经过试种观察或检疫、基本农艺性状鉴定、去除重复、编入《全国作物种质资源目录》后，才能成为国家种质资源收集品，并繁殖入国家种质库（圃）长期保存，而后进行深入鉴定评价并提供分发利用。截止 2007 年 12 月，收集品总量为 391,919 份，比 1996 年增加 32,956 份，其中种子收集品为 351,332 份，植株和试管苗收集品 40,587 份。据初步统计，在种子收集品中，国内收集品约占 82%，国外收集品约占 18％。在国内收集品中，地方品种约占 56%，稀有、珍稀和野生近缘植物约占 10％。

3.2 收集

自 1996 年以来，新增收集品 32,956 份，主要来源：第一，依靠国家粮食与农业植物遗传资源协作网的征集和收集，收集对象是各地区以前未收集到的地方品种、过去十多年新育成的品种以及具有重要研究价值的特殊遗传材料等；第二，通过国家项目进行野外考察收集，例如 1996-2000 年实施的“三峡库区粮食与农业植物遗传资源考察”、“赣南粤北粮食与农业植物遗传资源考察”；2001-2002 实施的“防沙治沙特种植物遗传资源调查、评价和利用”； 2006-2010 年实施的“云南及周边地区农业生物资源调查”等。第三，从国外引进植物遗传资源。

近年来实施的专项考察收集活动具有以下新特点：（1）注重特异、特色植物遗传资源以及野生种质资源的考察收集，同时调查特有资源的分布、特征特性、

生存环境、濒危状况，以及对当地农业、生态、人类生存发展所起的作用等，以便为更好地保护和可持续利用这些资源提供依据；（2）考察收集活动不再仅仅局限于收集资源，更加注重了解这些资源与当地人民生存发展的关系，以便为深入鉴定评价这些资源提供信息；（3）更加注重资源收集的科学性，确保收集品的遗传完整性；（4）研究制定了《农作物种质资源收集技术规程》（2007 年出版），进一步规范了考察收集（征集）、国外引种的程序、技术措施等。

3.3 收集品类型

已初步建立了国家粮食和农业植物遗传资源保存体系，包括国家长期库 1 座、国家复份库 1 座、国家中期库 10 座、国家种质圃 32 个（含 2 个试管苗库）。自 1996 年以来，新增基础收集品 32,501 份，基础收集品总数达 351,332 份，

表 3.1 国家长期库的基础收集品

作物	入库份数	物种数		物种数	入库份数	物种数
水稻	64210	21		棉花	7226	19
野生稻	5588			麻类	5071	7
小麦	41030	134		油菜	6300	13
小麦近缘植物	2009			花生	6565	16
大麦	18557	1		芝麻	4726	1
玉米	19088	1		向日葵	2646	2
粟类	26636	9		特种油料	7749	4
大豆	24931	4		西、甜瓜	2022	2
野生大豆	6644			蔬菜	30482	135
食用豆	25938	17		牧草	3712	387
烟草	3407	22		燕麦	3287	3
甜菜	1373	1		荞麦	2582	3
黍稷	8451	1		绿肥	663	71
高粱	18263	1		其它	2176	2
合计					351332	735

见表 3-1,并全部进行复份保存；繁殖更新了 286,604 份种质，充实了国家中期库的流动收集品,见表 3-2；田间收集品为 38,803 份，见表 3-3；离体收集品 1784 份，见表 3-4。

表3.2　国家中期库的流动收集品

序号	中期库名称	作物	份数
1	国家农作物种质保存中心	禾谷类、大豆、食用豆、杂粮	175600
2	国家水稻中期库	稻类	50768
3	国家棉花中期库	棉花	5350
4	国家麻类作物中期库	麻类作物	4426
5	国家油料作物中期库	油料作物	20769
6	国家蔬菜中期库	蔬菜	22265
7	国家甜菜中期库	甜菜	906
8	国家烟草中期库	烟草	2500
9	国家牧草中期库	牧草	2200
10	国家西甜瓜中期库	西瓜、甜瓜	1820
	合计		286604

表3.3 国家种质圃的田间收集品

序号	种质圃名称	作物	份数	物种数
1	北京桃、草莓圃	桃	195	4
		草莓	107	10
2	山西太谷枣、葡萄圃	枣	262	2
		葡萄	374	8
3	辽宁熊岳李、杏圃	杏	601	8
		李	499	8
4	吉林公主岭寒地果树圃	苹果、梨、山楂	358	44
5	江苏南京桃、草莓圃	桃	353	6
		草莓	153	12
6	福建福州龙眼、枇杷圃	龙眼	154	2
		枇杷	220	3
7	山东泰安核桃、板栗圃	核桃	129	9
		板栗	142	5
8	湖北武昌砂梨圃	梨	343	7
9	湖北武汉水生蔬菜圃	水生蔬菜	2924	49
10	广东广州野生稻圃	野生稻	3757	20
11	广东广州荔枝、香蕉圃	荔枝	89	1
		香蕉	234	6
12	广东广州甘薯圃	甘薯	1045	3
13	广西南宁野生稻圃	野生稻	3496	1
14	云南特有果树及砧木圃	特有果树及砧木	541	120
15	云南开远甘蔗圃	甘蔗	1921	15
16	新疆轮台特有果树及砧木圃	特有果树	450	31
17	辽宁沈阳山楂圃	山楂	175	10

18	陕西眉县柿圃	柿	356	7
19	辽宁兴城梨、苹果圃	苹果	579	24
		梨	585	15
20	重庆柑橘圃	柑橘	683	16
21	河南郑州葡萄、桃圃	葡萄	604	25
		桃	286	12
22	江苏镇江桑树圃	桑树	1910	1
23	浙江杭州茶树圃	茶树	1514	1
24	湖南长沙苎麻圃	苎麻	4485	28
25	北京小麦野生近缘植物圃	小麦	1695	219
26	湖北武昌野生花生圃	花生	40	33
27	海南野生棉种质圃	棉花	552	36
28	吉林左家山葡萄圃	山葡萄	250	1
29	海南儋州橡胶种质圃	橡胶树	6310	7
30	内蒙古多年生牧草圃	牧草	432	147
	合计		38803	956

表3.4　国家试管苗库的离体收集品

序号	种质圃名称	作物	份数	物种数
1	黑龙江克山马铃薯试管苗库	马铃薯	887	8
2	江苏徐州甘薯试管苗库	甘薯	897	8
	合计		1784	16

3.4 保存设施

1996-2007 年期间，农业部“种子工程”等项目投资近 1.2 亿元，用于保存设施扩建和现有设施改造，包括（1）扩建 2 座国家级种质库，即位于北京的“国家农作物种质保存中心”和位于青海的“国家种质库复份库”。“国家农作物种质保存中心”主要功能是承担粮食作物种质资源的中期保存和分发提供利用；（2）对稻、棉花、麻类、蔬菜、烟草、牧草、甜菜、油料等 8 座中期库进行设施改造，同时对国家种质库的制冷系统及前处理设备进行更新；（3）新建 7 个国家级种质圃，包括无性繁殖和多年生蔬菜种质圃（北京），野生苹果种质圃（新疆伊犁），杨梅（梅）种质圃（江苏南京），热带果树种质圃（广东湛江），木薯热带牧草种质圃（海南儋州），热带棕榈种质圃（海南文昌），热带香料饮料种质圃（海南兴隆）；（4）对 30 个国家种质圃的保存基础设施进行改造。这些保存设施的扩建和改造，极大提高了中国植物遗传资源的安全保存能力。截止 2007 年 12 月，保存设施现状见表 3-5。

表3-5　保存设施现状

序号	保存设施类型	数量		贮藏条件	
		原有	新增或在建	原有	改善情况
1	国家长期库	1		－18℃，RH≤57％	－18℃，RH≤50％；制冷设备全部更换
2	国家复份库	1		－10℃；贮存容量 40 万份	－18℃，RH≤50％；贮存容量增加至 60 万份
3	国家中期库	10		0～10℃	－4～＋4℃
4	省级中期库	12	17	0～10℃	0～10℃
6	国家种质圃	30	7		基础设施改造和扩建
7	国家试管苗库	2			基础设施改造和扩建

3.5 保存种质的安全性

影响种质库保存种质安全性的主要因素包括贮藏条件、种子生活力下降、遗传完整性变异等。影响种质圃保存种质安全性的主要因素包括自然灾害（含病虫害）、种质圃搬迁、种质衰老等。

3.5.1 种质库保存种质的安全性

贮藏条件　维持种质库低温恒定的贮藏条件是确保种质安全性的首要条件。

中国国家种质长期库采取双路供电，以确保电力不中断。另外加强种质日常安全管理，防止火灾等意外灾害事件的发生也是确保种质安全性的必要条件。国家种质库在2001年和2007年分别对运行20年的制冷设备和供电设施进行更新改造，以确保制冷设备和供电系统的长期正常运行。另外，长期库、复份库、中期库互为备份的种质保存体系，可有效避免因特殊原因而导致植物遗传资源的损失。

种子生活力下降　因种质老化而导致生活力下降，是影响种质安全性的最主要的生物学因素之一。从 1997 年开始，国家种质库开始对长期库贮藏 10-20 年部分作物种子进行生活力监测，累积监测 46 种作物 3.6 万余份种子。监测结果表明：（1）总体上没有明显下降（发芽率≥85%），但约 1.1%被监测种子发芽率明显下降(≤70%以下)，主要原因可能是因不同物种或同一物种不同品种的耐贮存性差异所致；（2）不同作物生活力下降存在明显差异，胡萝卜、莴苣、棉花、西瓜等生活力下降显著，部分短寿命种子即使在低温下仍表现出较差的耐贮性，如胡萝卜、莴苣等；（3）不同繁种地点对种子生活力下降也有影响；（4）入库时种子活力高的品种，一般能够保持更长时间的高生活力。

遗传完整性变化　减少种质贮藏和繁殖更新过程中的遗传变化，最大程度维持种质遗传完整性也是确保种质安全性的重要条件。国内外研究表明，因种质衰老而发生遗传变化（如染色体畸变），似乎对种质保存没有产生不利的后果。而种质更新时，种子发芽率水平、繁殖群体大小和种子收获取样方式等，则是维持种质遗传完整性的关键因素，尤其对遗传上异质材料。国家种质库研究者采用醇溶蛋白电泳技术检测小麦、利用 SSR 标记检测大豆种质的遗传完整性变化，供试材料各为 30 份。结果表明，更新时的发芽率是维持异质性种质遗传完整性的关键因素。此外，一些学者也对玉米、大白菜、荞麦、多花菜豆、薏苡和芝麻等 6 种作物最佳繁殖技术进行了研究，结果表明，玉米繁殖群体量为 200 株时，保持原种种质遗传完整性优于繁殖群体量为 100 株和 50 株。且从不同穗上获取等数量种子作为基因库种质保存材料，其群体的遗传多样性要高于从同一个穗中取等数量种子。因此，采取科学的繁种技术和取样方式，是维持异花授粉作物种质遗传完整性的重要措施。目前中国已经制定了“农作物种质资源繁殖技术规程”，规范了繁殖更新技术程序和技术指标，确保种质繁殖更新过程中，其遗传完整性不会丢失。

3.5.2 种质圃保存种质的安全性

影响种质圃保存种质安全性的主要影响因素有：自然灾害（含病虫害）、种质圃搬迁和种质衰老等。自然灾害，如水灾、冻害、病虫害等是影响种质圃种质安全性最主要的因素。1996 年 7 月，湖南沅江遭受特大洪水，苎麻圃被洪水淹没 49 天，造成 900 份种质丧失；2008 年 1 月，南方地区遭受了冰冻自然灾害，长沙苎麻圃和武汉水生蔬菜圃都遭受不同程度的冰冻危害；种质圃搬迁主要是由于城市扩建、大型水利和道路建设等，导致种质圃生态环境条件破坏，使得一些国家种质圃不得不搬迁。例如，国家种质苎麻圃于 2004 年 6 月从湖南沅江转移到了长沙；国家种质泰安核桃板栗圃于 1985 年建成，2003 年进行了整体保存圃搬迁。在搬迁过程中难免导致一些资源的丢失；种质圃种质衰老也是影响保存种质安全性的重要因素。

3.6 信息汇编

研究制定了农作物种质资源描述规范、数据标准和数据质量控制规范 336 个，形成了农作物种质资源科学分类、统一编目、统一描述的规范标准体系，已出版《农作物种质资源技术规范》丛书 110 册。

建成了拥有 180 种作物、39 万份种质信息的国家农作物种质资源数据库系统，包括国家作物种质库管理、青海复份库管理、国家种质圃管理、国家中期库管理、农作物特性评价鉴定、优异资源综合评价、国内外种质交换、农作物种质资源调查和种质图像等 11 个子系统，近 700 个数据库，135 万条记录，数据量达 100GB。

1996 年，建立了中国作物种质信息网（http://www.cgris.net/），2007 年，建立了国家植物种质资源信息共享网站，已向 100 多万人次提供了作物种质资源信息共享服务。

研制成功了中国作物种质资源电子地图系统、中国主要农作物种质资源特性分布信息系统、主要作物种质资源 WebGIS，设计了作物种质资源指纹图谱自动识别系统（GEL）、种质库种子繁殖更新专家系统（RES）、农业野生植物 GIS/GPS 等一系列应用软件。

3.7 供种分发

长期库 1998 年以来，云南农业科学院、山西农业科学院、江苏盐都农科所、

湖南水稻所、湖南原子能农业应用研究所、中国农业科学院烟草研究所等 120 多个单位，从国家作物长期库取出原保存单位已绝种的种质材料 6.5 万余份，作为原种材料进行繁殖更新，以补充中期库种源不足问题，提高了中期库分发供种能力。

中期库和种质圃　自 2001 以来，通过农业部“农作物种质资源保护和利用专项”的实施，共繁殖了 286,604 份种质资源，有效解决了中期库无种可供的局面。7 年来共向全国 2650 个单位，提供了 13.2 万份次种质资源，涉及作物种类达 220 余种（类），其中 10 座中期库分发供种 9.1 万份次，索取单位 1730 个。32 个国家种质圃分发供种 4.1 万份次，索取单位 920 个。索取资源的主要用途是，育种亲本、直接筛选利用、科学研究、博物馆标本及对外交换等，索取者主要是育种家、科研人员、教师、学生、农民、科普工作者等。另外，种质库（圃）还作为大中小学的教学、参观和实习基地，正在发挥科普教育的作用。

3.8 植物园的作用

中国植物园约有 170 多个,可分为 5 类：（1）以中国科学院植物园为代表的科学植物园，功能包括物种保存、科学研究、资源开发和公众教育等各个方面；（2）城建、园林或旅游部门建立的以植物展示和休闲娱乐为主的植物园，如北京市植物园、杭州植物园等；（3）教育部门建立的以植物教学、实习为主的植物园，如北京教学植物园、南京林业大学树木园等；（4）医药部门建立的以药用植物收集展示为主的植物园，如北京药用植物园、南宁药用植物园等；(5)农林部门建立的专门收集林木资源的植物园，如南岳树木园、长沙植物园等。部分植物园已经成为植物引种驯化、资源开发利用、迁地保护及园林景观建设的重要研究中心、资源宝库、科普教育基地。目前还没有专门承担粮食和农业植物遗传资源保护的植物园。

3.9 需要评估与优先发展重点

3.9.1 加强植物遗传资源的考察收集

中国虽已组织了多次植物遗传资源重大考察收集活动，但对于小宗作物、野生近缘植物和交通不便的边远山区的考察收集还很不够。随着经济的快速发展、农业生产集约化和山区开发步伐的加快，植物遗传资源损失日趋加速。因此，应进一步加强调查、考察与收集，避免中国特有和特异植物遗传资源的丢失。

3.9.2 建立和完善植物遗传资源保存体系

据测算，中国未来还有 15 万份植物遗传资源有待入库保存，目前的国家种质库库容已显然不足，因此，应建设新的国家长期库，扩大库存容量，同时增加试管苗保存库、超低温保存库、DNA 库。另外，还应继续建设新的种质圃。

3.9.3 加强种质安全保存技术研究

由于种子老化和遗传变异的发生机制仍不清楚，物种及品种间存在着寿命差异，种质入库前受伤害的不可知性，繁殖更新过程中的遗传漂移等，导致库存种质的活力下降难以预测和控制，因此，加强低温库安全保存种质的理论和技术研究尤为迫切，包括生活力监测技术，遗传完整性测定技术，临亡种质拯救技术，种质更新的发芽率标准及最佳繁殖技术等。另外，通过国际合作，应加强组织培养技术和超低温保存技术研究。

第四章 利用现状

粮食和农业植物遗传资源具有基础性、公益性、长期性和战略性的特点，是生物多样性的重要组成部分。充分利用粮食和农业植物遗传资源，是实现植物科学原始创新、粮食安全、生态安全、农业可持续发展和农民增收的物质基础和重要保障。

4.1 植物遗传资源利用及限制利用的因素

4.1.1 植物遗传资源的利用现状

植物遗传资源的利用可概括为以下四个主要方面：一是用于基础研究，揭示植物生长发育的分子生物学机理与系统演化关系，为植物科学的原始创新提供理论基础；二是用于优异性状鉴定和预育种活动，发掘新基因和创造符合育种目标的亲本材料；三是作为育种亲本材料用于培育新品种，为粮食安全提供保障；四是用于教学和展览，提高全民族植物遗传资源保护意识。

中国农业科学院原作物品种资源研究所通过发放调查问卷、实地调查、召开研讨会以及查阅资料等方式，对1984-1998年由国家种质库（圃）发放的13682份资源的利用情况进行了调查，发现约9%的资源用于基础研究，8%的资源用于育种活动，21%的资源用于优异性状鉴定和预育种活动，其余约62%的资源用于教学、展览或还未得到利用。在被利用的资源类型中，育成品种占38.8%，高代材料32.5%，地方品种22.4%，野生材料4.1%，遗传材料2.2%。

特别需要指出的是，植物遗传资源在新品种培育方面发挥了重要作用。自1950年以来，中国主要作物品种已更换4-6次，良种覆盖率达到85%以上。每次品种更新换代都使产量增加10％左右，作物的抗性与品质也显著提高，其中优异遗传资源在植物育种及种子产业中的贡献率达50%以上。

4.1.2 限制植物遗传资源利用的因素

十多年来，中国在植物遗传资源利用方面取得了显著成效，但从发展的角度分析，依然存在一些限制利用的因素。主要表现在：一是对这些遗传资源的基因水平研究滞后于育种需求。尽管在基因型鉴定方面也开展了部分工作，但涉及的作物种类及其资源数量极为有限，对库存 39.2 万份遗传资源的基因多样性水平、新基因数量、功能、利用价值等缺乏系统、深入研究，也就很难为育种家和基础

理论研究者提供针对性资源。二是尚未建立完善和明确的利益分享机制。如何从绩效考核、知识产权共享等方面体现资源工作者的权利与义务，目前还没有具体的政策和规章，致使资源提供者很难获得资源利用效果的信息。三是面对育种新需求，急需建立新的鉴定评价标准。随着气候变暖和生态环境的变化，育种目标需要调整，遗传资源鉴定评价的重点性状也必须随之调整，因此，就需要针对新的性状制定新的鉴定评价标准，从而鉴定筛选出符合育种家需求的新种质。

4.2 植物遗传资源鉴定评价与提供利用

4.2.1 鉴定与评价

为了获得更加科学、可信的鉴定数据，中国编制了《农作物种质资源技术规范丛书》，指导植物遗传资源的表现型鉴定工作。同时，开展遗传多样性评价、新基因发掘与功能验证等基因型鉴定工作。对鉴定筛选出的携带育种家需求目标性状的优异资源进行多年、多点的鉴定评价与田间展示。

表现型鉴定与评价　主要开展了植物学性状、产量性状、抗病性、抗虫性、抗逆性、营养成分和加工品质、氮和磷高效利用等性状的鉴定与评价。与以前开展的表现型鉴定评价相比，2000年以后，加强了主要病害中多个不同生理小种的鉴定、氮和磷高效利用鉴定、抗旱耐盐性的全生育期鉴定、铁和锌等微量营养成分鉴定，并特别注重了同一遗传资源不同表现型性状鉴定与评价的完整性。总体来看，中国保存的植物遗传资源蕴含丰富的优异性状，例如，在已鉴定的栽培稻资源中，对稻瘟病免疫的达835份，占鉴定种质的1.8%；高抗白叶枯病2685份，占5.9%；高抗褐稻虱2319份，占5.2%；高抗白背飞虱2841份，占8.2%；芽期耐寒种质3512份，占17.1％；苗期抗旱种质3170份，占14.9％；耐盐种质580份，占3.2%。

遗传多样性评价　综合利用形态学、蛋白质、DNA标记等分析方法，近年来重点开展了不同年代育成品种的遗传多样性变化、地方品种的遗传构成、多样性的地理分化等方面的研究。例如，对中国1950年以来选育的310个水稻品种的遗传多样性分析结果表明，不同年代间遗传多样性差异显著，以50年代选育品种遗传多样性最高，随之选育品种的遗传多样性呈下降趋势，近10年选育品种的遗传多样性又有所回升。籼稻品种遗传多样性下降程度明显高于粳稻品种。对小麦133个地方品种的遗传多样性分析发现，遗传多样性最丰富的麦区是黄淮冬麦区和西

南冬麦区；遗传多样性最低的麦区为华南冬麦区和东北春麦区；小麦地方品种尽管在主要农艺性状上表现出很大的一致性，但75%以上品种内的个体间为混合基因型，不同基因型间以相对稳定的比例存在，而每一个体为纯合基因型；不同小麦单株间，在品质和抗病性上存在丰富的等位基因多样性。对大豆1863个地方品种遗传多样性分析的结果表明，地方品种以地理分化为主，生态型分化为辅，说明自然选择和人工选择共同作用，形成了遗传多样性丰富的大豆地方品种。

核心种质构建　在表现型鉴定与遗传多样性分析的基础上，借助现代分子标记技术，构建了水稻、小麦、玉米、大豆、棉花、大麦、谷子等农作物的核心种质，并建立了水稻、小麦、玉米、大豆等农作物的微型核心种质。以微型核心种质为材料，深入分析其可能携带的优异基因，并为这些基因找到分子标记，为分子标记辅助育种奠定基础。另外，以微型核心种质为供体亲本，与生产上的主栽品种杂交、回交，拓宽育种遗传基础，培育高产、抗病、抗旱、耐盐碱、适应性广、品质好的新品种。

功能基因发掘　针对育种和生产中的主要目标性状，运用现代分子生物学的理论和技术，发掘了大量的重要功能基因，特别是与产量、品质、抗旱性等相关功能基因的发掘成效显著。例如，从普通野生稻中找到了能使杂交稻产量分别提高25.9%和23.2%的两个基因位点；通过分子标记与图位克隆的方法，分离出水稻分蘖控制基因*MOC1*；从小麦遗传资源中，发现了能够显著提高穗粒数的基因位点；从棉花基因资源中发现了与纤维发育相关的基因位点。这些功能基因的发掘，为基因工程育种奠定了基础。

精准鉴定与田间展示　2005 年以来，对水稻、小麦、玉米、大豆、棉花、油菜等主要农作物遗传资源中携带育种家需求目标性状的优异资源，在 3-5 个生态区进行 3-5 年的精准鉴定与评价，并进行田间展示，邀请育种家现场考察，选择符合育种目标的种质，提高优异遗传资源的利用效率。

4.2.2 预育种与种质创新

为了拓宽育种遗传基础，近年来通过远缘杂交等手段，将外源物种的期望基因转入栽培种，并在方法和材料创新方面取得显著进展。

围绕高产、优质、抗病、抗逆等育种目标，创造一批育种新材料和遗传材料，例如，将普通野生稻的 *yld1.1* 和 *yld2.1* 两个高产基因位点转入栽培稻，创造出超级稻候选骨干亲本“Q611”（恢复系），并开始提供育种家利用；通过普通小

麦与冰草（*Agropyron cristatum* 〈L.〉 Gaertn.， 2n=4x=28， PPPP）间的杂交，已创造出涉及冰草多花多粒、抗旱、抗白粉病和条锈病等基因的普通小麦－冰草异源易位系 30 余个，育种家利用后已培育出普通小麦新品种 2 个；利用辐射诱变技术，创造出大铃、纤维品质优异的棉花新材料，培育出大铃优质杂交棉“中棉所 48”，正在生产上推广利用。

4.3 植物遗传资源多样性的利用

随着对现代栽培品种遗传基础分析的不断深入和主要病害生理小种的不断变化，育种家在培育抗病虫、抗逆等新品种以及品种多样化种植方面，更加注重对遗传资源多样性的利用。

4.3.1 高产育种

高产始终是中国作物育种最重要的目标，发掘和利用植物遗传资源中具有潜在高产特性的种质或基因就显得十分重要。例如，在水稻育种中，利用新发现的光周期敏感核不育水稻种质“农垦 58S”，实现了利用广亲和性与光敏核不育基因，开展籼粳亚种间杂种优势利用的高产育种新战略，并相继培育出“两优培九”、“培两优 288”、“香两优 68”、“培杂双七”等一批优良两系组合，其中，“两优培九”于 1999-2000 年在湖南、江苏省的 34 个示范片共 500 多公顷面积上，平均单产超过每公顷 10.5 吨，2001 年在全国推广 113.3 万公顷，平均产量达每公顷 9.2 吨。

4.3.2 优质育种

中国作物育种已从单纯追求产量转变为产量和品质的协同提高，新育成品种的品质有了明显的改善。例如 1993 年～2004 年选育的 605 个大豆品种中，蛋白质含量在 45％以上的有 103 个，占 17.0%， 脂肪含量在 22％以上的品种有 71 个，占 11.7％。在桃优质育种方面，利用中国蟠桃地方品种“陈国蟠桃”、“百芒蟠桃”，改良商业栽培桃和油桃品种，育成了 20 多个“桃瑞”系列新蟠桃品种，克服了地方品种果实软、裂顶和产量低等缺点，保持了蟠桃香甜的优点，1996-2007 年间，栽培面积超过 50 万亩，较 1996 年增长了 2 倍以上。

4.3.3 抗病虫育种

在抗病虫育种方面，更加注重携带广谱抗性基因、新基因、抗多种病虫害基因的遗传资源的利用。例如，利用 1 个对水稻白叶枯病具广谱抗性的资源，培育出通过国家和省级审定的杂交稻新品种各 2 个；利用小麦抗条锈病新基因资源，

培育出“川麦 42”等小麦新品种，这些品种不仅抗当前流行的条锈病条中 30、31 和 32 号等生理小种，解决了 2000 年之后西南麦区小麦品种的抗条锈病问题，而且成为目前西南麦区培育高产品种的重要亲本材料；利用兼抗玉米青枯病、矮花叶病、灰斑病和玉米螟的资源，培育出的新品种不仅抗病虫综合能力显著提高，而且千粒重比对照品种“郑单 14”提高了近 50 克。

4.3.4 抗旱育种

近年来，在水稻、小麦、玉米等主要粮食作物育种中，抗旱、节水育种已成为主要育种目标之一，并取得了显著成效。例如，利用筛选出的小麦优异抗旱资源“晋麦 63”和“82230-6”，并提供小麦育种家利用，育成新品种 6 个，其适应范围跨越中国黄淮冬麦区旱地、北方冬麦区旱地和北方冬麦区水地三大生态区，其中新品种“长 6878”在北方冬麦区旱地累计种植面积达 1931 万亩，约占当地种植面积的 65%。

4.3.5 植物多样化种植

植物多样化种植是中国农业的优良传统，近年来不仅得到进一步加强，而且利用同一作物不同品种的搭配种植，控制病虫害。例如，云南农业大学与国际水稻研究所合作，从 1998 年起在云南、四川、江西等省开展了利用水稻品种多样性，进行抗、感水稻品种混合种植，以控制稻瘟病的发生。利用高产杂交水稻汕优 63、汕优 22 与感稻瘟病优质糯稻品种黄壳糯、紫糯进行混合间植，与优质糯稻品种单植相比较，混植田块的稻瘟病严重度减少 80%左右，增产 6.5%～8.7%，增加收益约 10%。

4.4 需要评估与优先发展重点

4.4.1 加强植物遗传资源的深入鉴定和系统评价

针对生产和育种中急需的重要性状或基因，完善或建立植物遗传资源评价技术标准和方法，大规模开展深入鉴定评价工作，发掘地方品种和野生种中高产、优质、抗病虫、抗逆等目标性状基因，明确其功能，提供育种利用，拓宽育种遗传基础狭窄问题，提高植物遗传资源的利用效率。

4.4.2 加强生产上主栽品种优良特性研究

以生产上大面积推广种植的优良品种为材料，全面系统的研究其优良性状的构成特点，探索这些优异性状形成的分子生物学基础和遗传规律，指导植物遗传

资源的鉴定和种质创新，使鉴定出的资源和创造出的种质更加符合育种家的需要。

4.4.3 开展功能保健特性研究

基于中国丰富的植物遗传资源，筛选、鉴定富含功能保健作用的种质，研究功能保健因子的遗传特性和利用途径，研制开发功能保健产品，培植新型产业，增加农民收入，促进人类健康。

第五章 国家计划、培训和立法现状

中国政府通过制定和实施国家相关计划，加大培训力度，提高植物遗传资源管理人员和公众意识，并通过立法和完善相关制度，加强了植物遗传资源的安全保护和可持续利用。

5.1 粮食和农业植物遗传资源国家计划

1994年，中国政府发布了《中国21世纪议程》和《中国生物多样性保护行动计划》，1996年发布了《国民经济和社会发展“九五”计划和2010年远景目标纲要》，2006年发布了《国家中长期科学和技术发展规划纲要 （2006-2020年）》，这些国家规划和计划都把粮食和农业植物遗传资源的保护和利用作为重点领域或优先主题，并在国家 “973”、“863”、科技支撑、科技基础条件平台建设等四大国家主体科技计划以及“种子工程”、“农业野生植物资源保护”等重大专项中，共设立和实施了12个关于粮食和农业植物遗传资源保护和利用的国家项目，取得了显著成效。

2000年农业部启动了农作物种质资源保护与利用项目，繁殖更新了286,604份农作物种质资源，开展了农作物种质资源的精准鉴定和评价。2003年科技部启动了农作物种质资源平台建设项目，研究制定了120种作物种质资源的描述规范、数据标准和数据质量控制规范，出版了《农作物种质资源技术规范丛书》110册；完成了15.2万份种质资源的整合、标准化整理、编目和数字化表达。1998年开始实施“973”项目“农作物核心种质构建、重要新基因发现与有效利用研究”，利用现代生物技术，特别是植物基因组学的理论与方法，研究开发中国丰富的作物种质资源，解决育种亲本遗传基础狭窄问题，为中国农业的持续发展奠定基因资源基础。2002年启动的农业野生植物考察收集和原生境保护计划（2002-2010），旨在查清《国家重点保护野生植物名录》（农业部分）191个物种的分布状况，选择有代表性的居群建立农业野生植物原生境保护区（点）。目前已基本查清了大部分农业野生植物物种的分布状况，建立了86个农业野生植物原生境保护点，其中以野生稻、野生大豆和小麦野生近缘植物为主。2005年启动的农作物野生近缘植物保护与可持续利用计划（2005-2011），目标是将野生近缘物种的保护与农业生产相结合，促进中国作物野生近缘植物保护的可持续发展，增加农民收入。

此外，“十一五”科技支撑项目“农业基因资源发掘与种质创新利用研究”、“973”项目“农作物骨干亲本遗传构成和利用效应的基础研究”、“云南及周边地区农业生物种质资源调查”及“沿海地区抗旱耐盐碱优异性状农作物种质资源的调查” 等多个国家重大科技计划正在实施，极大地促进了中国粮食和农业植物遗传资源的保护和利用。

5.2 粮食和农业植物遗传资源工作培训

随着中国粮食和农业植物遗传资源国家计划的相继实施，对管理人员、科研人员和社会公众的素质要求也愈来愈高。为此，中国政府制定了专门的培训计划，拨付专项经费，加强培训工作。

十多年来，中国农业部组织或委托地方农业厅、农业科研院校组织了近百次培训班（会议），并通过广播、电视、报刊等形式宣传保护粮食和农业植物遗传资源多样性的重要意义，提高了公众意识。2002年12月，农业部分别在青海省西宁市、湖北省宜昌市组织举办了两期农业野生植物保护与管理培训班，全国31个省市及农业野生植物保护示范点承担单位的管理、技术人员参加了培训。2002年12月，农业部与农业广播学校共同举办了“生态农业与农村可持续发展远程培训班”。2006年10月，广西壮族自治区在南宁举办了《中国濒危野生动植物进出口管理条例》培训班。2007年10月中国农业科学院在北京举办了植物种质资源图像采集与加工处理培训会，进一步提高了资源图像采集的质量。2008年4月科技部举办了植物遗传资源调查工作培训，保证调查数据的准确性和科学性。2008年4月，农业部举办了全国植物遗传资源管理人员培训班，来自各省（市）农业厅、各科研教学单位的120余人参加了培训，取得了良好效果。

在中国政府的支持下，通过多种途径，宣传粮食和农业植物遗传资源的重要性，贯彻相关的法规政策，培训农民参与式的粮食和农业植物遗传资源保护知识，提高了全社会保护粮食和农业植物遗传资源的公众意识，有力地促进了中国粮食和农业植物遗传资源的保护和利用工作。

5.3　粮食和农业植物遗传资源法规体系建设

5.3.1 相关法律的颁布

1996年以来，中国政府颁布实施了《中华人民共和国种子法》（2000年）、《中华人民共和国畜牧法》（2006年）等涉及植物遗传资源的法律，其中《中华

人民共和国种子法》规定，国家依法保护种质资源，禁止采集或者采伐国家重点保护的天然种质资源。国家有计划地收集、整理、鉴定、登记、保存、交流和利用种质资源，国务院农业、林业行政主管部门应当建立国家种质资源库、种质资源保护区或种质资源保护地。

5.3.2 相关法规的制定

根据农业生物多样性保护与可持续利用的需求，国务院和相关部委制定了一系列法规条例，促进了农业生物多样性的保护工作。

《中华人民共和国野生植物保护条例》（1996年）规定任何单位和个人都有保护野生植物资源的义务，禁止任何单位和个人非法采集野生植物或破坏其生长环境。在国家重点保护野生植物的天然集中分布区域建立自然保护区。对生长受到威胁的国家重点保护野生植物应当采取拯救措施，必要时应当建立繁育基地、种质资源库或采取迁地保护措施。

《农业转基因生物安全管理条例》（2001年）规定，农业转基因生物安全不仅要防范农业转基因生物对人类、动植物和微生物构成的危险，而且要防范其对生态环境构成潜在风险。该条例对农业转基因生物的研究、试验、生产、加工、经营和进口、出口活动都做出了明确的规定，并按照危险程度，将农业转基因生物分为I、Ⅱ、Ⅲ、Ⅳ四个等级，实行分级管理。

《农作物种质资源管理办法》（2003年）明确指出，国家依法保护和监督农作物种质资源及其收集、整理、鉴定、登记、保存、交流、利用和管理等活动，任何单位和个人不得侵占和破坏种质资源；国务院农业、林业行政主管部门应当建立国家种质资源库、种质资源保护区或者种质资源保护地。对植物种质资源的收集、整理、鉴定、登记、保存、交流、共享和利用等各项工作进行了规范。同时，制定了国家种质库（圃）管理细则，建立了植物种质资源统一编号制度和优异种质资源评审、登记制度，建立了植物种质资源分发利用制度等，构建了较完善的植物种质资源政策法规体系，为中国植物遗传资源的有效管理和高效利用奠定了基础。

5.3.3 相关机构的建设

2001年，农业部成立了农业野生植物保护领导小组，主要负责研究提出解决农业野生植物保护相关重大问题的对策和原则意见，组织协调野生植物保护执法

管理工作，组织制定全国野生植物保护工作的计划、规划，研究提出野生植物保护工作的重大措施，指导各级农业部门野生植物保护的执法管理工作。

2003年，农业部成立了农业转基因生物安全管理领导小组，设立了农业转基因生物安全管理办公室；建立了由农业部、商务部、卫生部、科技部、国家质检总局、国家环保总局等部门负责人组成的农业转基因生物安全管理部际联席会议制度。并成立了国家农业转基因生物安全委员会，负责农业转基因生物的安全评价工作。

2004年，农业部与林业局共同成立了中国野生植物保护协会。协会的宗旨是在国家保护野生植物方针指导下，团结组织社会各方面的力量，宣传国家有关政策和法令，普及和推广野生植物知识，提高全民族的野生植物保护意识，有效保护、合理利用中国的野生植物资源，推动中国野生植物保护事业的发展。

5.4 需要评估与优先发展重点

到2020年，中国将继续支持现有正在实施的粮食和农业植物遗传资源的国家计划，加强投入力度，重点围绕《全球行动计划》20项优先领域，开展粮食和农业植物遗传资源的系统调查、安全保护、鉴定评价、创新利用、新基因发掘等工作；加强粮食和农业植物遗传资源保护社会公众意识的宣传和培训，强化粮食和农业植物遗传资源保护和利用技术培训，继续开展粮食和农业植物遗传资源保护管理知识培训；继续完善粮食和农业植物遗传资源相关法律法规，建立粮食和农业植物遗传资源协调机制，健全市、县级粮食和农业植物遗传资源管理体系。

第六章 地区和国际合作现状

世界各国自然环境和气候条件各异，原产或引进后驯化的植物遗传资源各具特色。历史悠久的世界农业发展史已充分证明，没有任何一个国家仅依赖本国的植物遗传资源就很好地解决了其植物育种和农业生产问题。同时，任何一个国家的植物遗传资源的破坏或灭绝，都直接或间接地影响到全人类的生存和发展。因此，加强地区和国际合作，安全保护和可持续利用植物遗传资源，是世界各国政府、非政府组织、企事业单位和每一位公民的义务和责任。

中国是植物遗传资源十分丰富的国家，中国政府历来高度重视植物遗传资源的保护、研究和利用，同时，也十分重视通过地区和国际合作保护和利用本国乃至全球的植物遗传资源。十多年来，仅通过中国农业科学院就向美国、英国、菲律宾、IRRI、CIMMYT等100多个国家或国际组织提供了120种植物11288份植物遗传资源，这些植物遗传资源的交换，为世界植物育种、农业生产的发展发挥了较大作用。

为实现全球植物遗传资源的安全保护和可持续利用，还积极与其他国家建立了协作网，签署了国际协议，并通过国际项目，促进全球植物遗传资源保护和利用体系的建设。

6.1 积极参与国际协作网络，促进全球植物遗传资源共同发展

6.1.1 作物协作网

中国政府鼓励农业研究机构积极参与和加入有关植物遗传资源保护和利用的国际协作网，通过协作网活动，促进各成员之间的联系，加强植物遗传资源交换和技术交流。

中国水稻所等单位参加了国际水稻遗传评价网(INGER)，向有关单位提供了560份水稻资源，并参加了水稻资源全球评价与利用，并通过该协作网从其他国家引进了6000余份水稻资源。通过利用INGER 种质资源，中国有关单位培育的水稻品种累计种植面积已超过1500万公顷，增加水稻产量超过550万吨。

广东省农业科学院代表中国参加了国际香蕉大蕉改良协作网（INAPAB），在广西、云南和海南省进行了香蕉资源考察，并把收集的材料在广东湛江复份保存，

收集材料的鉴定数据提供给INIBAP，录入了“国际香蕉种质资源信息系统”。

中国热带农业科学院椰子研究所参加了国际椰子遗传资源协作网(COGNET)。自1997年以来，先后开展了椰子资源收集、鉴定和保存等项目，通过间作和原生境保护提高种植椰子的农民收入。

6.1.2 地区协作网

东亚植物遗传资源保护和利用协作网成员包括中国、日本、朝鲜、韩国和蒙古。中国农业科学院代表中国参加该协作网有关活动。通过该协作网，中国农业科学院作物科学研究所、广西农业科学院等单位参加包括红小豆资源考察、鉴定与评价研究，谷子和黍稷种质资源收集与鉴定，苡薏资源收集、鉴定与保护研究等。东亚植物遗传资源保护和利用协作网有力地推动了东亚国家中间的合作。

6.1.3 大型合作项目网络

挑战计划是有关作物遗传资源国际性研究计划，是由国际农业研究磋商组织及一些发展中国家倡议设立的，中国是倡议国之一，也是重要的合作伙伴。中国农业科学院作物科学研究所参加了该计划中作物资源遗传多样性鉴定等多个项目，包括水稻、玉米、小麦、大麦、食用豆等资源评价与优良基因发掘工作。通过该项目形成的网络，极大地促进了种质资源交换和共享，在发掘优良育种材料，促进优良基因的利用方面发挥了积极作用。

在亚洲发展银行的支持下，亚太地区的有关国家联合开展了“亚洲热带果树种质资源保护与利用研究”项目。中国农业科学院柑橘研究所、中国热带农业科学院、广东省农业科学院等单位参加该合作项目，开展的活动包括柑橘、芒果和荔枝种质资源收集、鉴定、保存和数据库建立等。通过该项目，与项目合作国家的有关单位建立了密切联系，进行了技术交流和信息交流，促进了国家间合作。

6.2 广泛开展国家间合作，促进植物遗传资源交换与共享

中国农业科学院等农业研究机构与很多国家相关农业研究机构建立了合作关系，如中国-巴西、中国-俄罗斯、中国-澳大利亚、中国-法国、中国-乌拉圭等。中国农业科学院还与乌拉圭农牧研究院、保加利亚农科院等单位先后签署了关于开展植物种质资源交流的科技合作备忘录。

6.2.1 资源交换、鉴定与评价

通过国家间合作，交换了作物遗传资源，开展了联合鉴定，筛选优良资源，

促进利用发展。中国农业科学院作物科学研究所与俄罗斯瓦维洛夫植物研究所合作，开展了 800 份俄罗斯小麦资源的更新，黑龙江省农科院也与俄罗斯有关单位开展了小麦、大豆、玉米、马铃薯、沙棘、黄瓜、亚麻等种质资源交换工作。在中美合作中，中国提供 500 多份大豆地方品种，分别在中国和美国开展了联合评价，筛选出了抗大豆孢囊线虫的优异资源，在育种中发挥了重要作用。中澳开展了食用豆类资源的交换和联合鉴定，相互交换了 600 多份蚕豆和豌豆种质资源，并在中国的云南、青海收集蚕豆、豌豆各 95 份，向澳大利亚有关单位提供豌豆 298 份，蚕豆 95 份，从澳大利亚引进豌豆资源 602 份，蚕豆资源 305 份（系），通过鉴定，筛选出适合在中国栽培的蚕豆、豌豆品种，已在西北、西南地区种植，提高了产量和品质。

6.2.2 科技交流与培训

中国-巴西，中国-俄罗斯，中国-阿根廷，中国-美国，中国-韩国等，开展了科学家互访，进行了广泛的科技交流，有效地促进了相互了解，加强了合作关系，促进了种质资源交换。

中国华中农业大学为其他发展中国家培养种质资源分子鉴定研究人员，河北农科院果树研究所等单位为东南亚一些国家培养了种质资源超低温保存技术人员。

6.3 签署和加入国际协议，促进植物遗传资源多边体系建设

6.3.1 生物多样性公约

中国是《生物多样性公约》签署和批准最早的国家之一。中国对履行《公约》持认真的态度，围绕保护和持续利用生物多样性、公平合理地分享其利益的目标，积极开展一系列国际、国内履约活动，成立了由国家环境保护总局牵头，20 余个部门参加的"中国履行《生物多样性公约》工作协调组。发布了《中国生物多样性国情研究报告》，制定了《中国生物多样性保护行动计划》，加强了立法建设，促进了生物多样性原生境和非原生境保护，强化了公众宣传教育和培训，有效地保护了中国的生物多样性。

6.3.2 国际植物遗传资源条约

中国尚未加入《粮食和农业植物遗传资源国际条约》，但中国政府认识到该《条约》的重要性，赞同该《条约》的目标，促进粮食和农业植物遗传资源的保

护和可持续利用，公平合理地分享利用这些遗传资源所产生的利益，最终实现粮食安全和农业可持续发展。

6.3.3 国际植物新品种保护联盟

1999 年 4 月 23 日中国加入《国际植物新品种保护联盟（UPOV)》1978 年文本，成为该联盟第 39 个成员国。中国遵循联盟宗旨，承认和保证符合条件的植物新品种育种家及其合法继承者的权利。目前中国已经公布了 7 批共 74 个属（种）被列入新品种保护名录（林木除外）。这些植物新品种的保护，极大地保护了育种家的合法权益，调动了育种家的积极性，促进了育种事业的发展。

6.3.4 全球环境基金

全球环境基金（GEF）在生物多样性的保护中发挥了重要作用。自成立以来，中国得到了该基金的大力支持。在农业生物多样性领域，支持中国开展了作物野生近缘种的保护，包括小麦野生近缘植物、野生水稻、野生大豆的保护。在该基金的支持下，还开展了利用作物遗传多样性防治病虫害，促进农业可持续发展项目，开展了水稻、玉米、大麦、蚕豆等作物不同模式的间种和混种，有效地控制了病虫害的发生，减少了农药的使用，降低了生产成本，增加了农民收入，保护了生态环境。该项工作正在云南、四川、贵州等省的 6 个试验点开展，取得成功经验后在更大范围推广。

6.4 加强与国际组织合作，促进植物遗传资源保护与利用

中国加强了与国际组织在植物遗传资源领域的合作。截止 2007 年，中国 50 多个研究机构与 CGIAR 的 11 个中心与开展了合作活动，中国农业科学院与大多数 CGIAR 研究中心签署了科技合作谅解备忘录，有 10 个中心在中国农业科学院设立了办事处，有 3 个中心与中国农业科学院建立了联合实验室，如 CAAS-Bioversity 农业生物多样性中心、CAAS-ILRI 牧草资源实验室等。

6.4.1 收集与引进

在国际组织支持下，有关单位开展了多次考察收集活动，涉及禾谷类作物、果树、椰子、水生蔬菜、药用和油料植物，共收集到 5000 余份材料。中国从 CIMMYT 获得了 10000 多份小麦遗传资源，从 IRRI 获得了 9421 份栽培稻和 1574 份野生稻资源，从 CIP 引进了马铃薯种质资源 3958 份，甘薯资源 839 份。广东省农科院从 ICRISAT 引进了 1500 份花生种质资源。

6.4.2 鉴定与评价

中国有关农业研究机构与 CGIAR 中心合作，开展了荞麦、红花等作物资源鉴定，建立了数据库。中国农业科学院作物科学研究所与 Bioversity 合作，开展了荞麦资源遗传多样性研究，采用 ISSR 和 AFLP 分子标记，对来自全国各地的苦荞资源进行遗传多样性分析，确定了不同地理来源苦荞材料之间的关系，建立苦荞分子评价体系。Bioversity 与广西农科院合作，开展了薏苡资源遗传多样性研究，对来自中国、日本和韩国的薏苡资源进行农艺特性评价和遗传多样性分子评价，利用 AFLP、SSR 标记，对薏苡资源的多样性进行了评价。

6.4.3 繁殖与保存技术研究

Bioversity 与中国有关单位合作，开展了不同作物的繁殖方法和保存技术研究。中国农业科学院作物科学研究所开展了荞麦、薏苡、大白菜、多花菜豆、芝麻五种作物的种质繁殖方法研究、种子超干燥贮藏技术研究，河北昌黎果树研究所开展了温带果树资源超低温保存技术研究，在苹果、梨、葡萄、猕猴桃等温带果树上获得成功。中国科学院成都生物所在四川凉山彝族自治州开展了苦荞麦农田保存可行性研究，评估了不同农业生态环境中的苦荞遗传资源多样性以及农业社团在保存苦荞种质资源中的作用。

6.4.4 分发利用

中国农业科学院油料作物研究所与 Bioversity 合作，评价了 4251 份芝麻遗传资源的多样性，建立了由 453 份芝麻资源组成的核心种质。中国农业科学院作物科学研究所与 Bioversity 合作，开展了国家基因库保存资源利用状况调研，研究发现，基因库分发的作物种质资源有 21%用于评价鉴定、8%用于育种、9%用于基础研究。

Bioversity 与云南农业大学、四川省农科院、贵州省农科院等单位合作，开展了利用遗传多样性控制病虫害促进农业可持续发展研究。通过不同种植模式，在生产上利用水稻、玉米、大麦、蚕豆的地方品种，有效控制了病虫害发生，减少了农药使用，增加了农民收入，保护了遗传多样性和农业生态环境。

6.4.5 信息服务与管理

在过去十多年间，CGIAR 向中国合作伙伴免费提供了大量科技图书和技术资料，并把一些重要技术图书翻译成中文进行分发，使中国很多资源工作者受益。

特别是 Bioversity 与中国有关单位联合开发了一系列种质库数据管理、电子种质目录和检索种子贮藏习性信息的计算机软件系统，并在世界范围内分发使用。

6.4.6 资源管理能力建设

在 CGIAR 的支持下，中国举办了多个培训班，共培训植物遗传资源科学家 100 多名，其中包括 30 名妇女。50 多人在海外接受了短期培训，极大地提高了中国植物遗传资源的管理能力。

6.5 需求评估与优先发展重点

通过国际合作，建立植物遗传资源信息交流平台，了解国际植物遗传资源的最新研究动态，促进中国植物遗传资源的保护和可持续利用；通过FAO统一协调，建立植物遗传资源，特别是野生资源的原生境保护、地方品种农场保护的技术方法体系，建立预警体系；进一步筹集作物多样性基金，扩大资助范围和力度，加强植物遗传资源的更新、保护和利用。

第七章 植物遗传资源获取和利益分享以及农民权利

有关粮食和农业植物遗传资源获取和利益分享的国际法律及政策框架已初步建立，包括《生物多样性公约》、《粮食和农业植物遗传资源国际条约》等。中国政府也正在制定或修订国内有关法律法规，促进植物遗传资源的方便获取和利益分享，实现农民权利。

7.1 植物遗传资源获取和利益分享的国际法律及政策框架

《生物多样性公约》和《粮食和农业植物遗传资源国际条约》明确规定，各国对其生物遗传资源拥有主权，但各缔约方依照本国法律，在事先知情同意的前提下，方便其他缔约方方便获取其遗传资源，同时实现公平合理的利益分享和农民权利。《粮食和农业植物遗传资源国际条约》还规定，各缔约方在植物遗传资源交换中，应签署标准材料转让协定（SMTA），各缔约方从多边体系中获得的材料，形成产品销售总额的 1.1%扣除 30%的成本后，提交条约管理机构建立的财务机制，用于植物遗传资源的保护和利用。另外，还规定遗传资源获得者不得对来自多边体系的原始状态的材料或其遗传成分申请任何限制第三方进一步研究利用的知识产权。

7.2 中国植物遗传资源获取现状及存在的问题及对策

中国于 1992 年签署了《生物多样性公约》，成立了由国家环境保护总局牵头，20 余个部门参加的履约工作协调组，并积极参与国际合作，推动资源获取与利益分享。中国目前尚未加入《粮食和农业植物遗传资源国际条约》，但自始至终参加了该《条约》的谈判，同意和支持植物遗传资源方便获得、实现利益分享的原则，并努力推动中国植物遗传资源的对外交流和交换，为全球粮食安全和农业可持续发展做出贡献。

目前，中国还没有建立专门的植物遗传资源获取和利益分享的法律体系，但在现有的一些法律法规中，已经对植物遗传资源获取作了规定，在《种子法》第二章“种质资源保护” 条款中，对种质资源的保护、采集、管理和对外交换作出了相关规定，建立了对外提供种质资源的行政审批制度。2003 年农业部颁发的《农作物种质资源管理办法》，更加具体地规范了农作物种质资源的收集、整理、鉴定、登记、保存、交流、利用和管理等活动。

中国政府及有关机构一直努力促进遗传资源的方便获取，并与多个国家签署有关植物遗传资源交换的合作协议，如 2002 年中美签署《中国科技部与美国农业部农业科技合作议定书》，在该《合作议定书》框架下，包括了《促进植物遗传资源交换的协议》，旨在促进双方的植物遗传资源交换和共享。中国政府积极支持中国的科研机构与国外科研机构进行植物遗传资源交换，如中国农业科学院与俄罗斯、巴西、阿根廷、澳大利亚、法国、乌拉圭等国家的有关农业研究机构签署了相关合作协议，遗传资源交换是合作协议的主要内容之一。在过去的十多年中，中国的有关机构通过交换等方式，从其他国家引进植物遗传资源约 3.0 万份，向其他国家提供了约 4.0 万余份植物遗传资源。获取遗传资源主要用于开展联合鉴定，筛选育种亲本材料，以及开展遗传多样性研究等。

尽管国际上一直努力促进植物遗传资源的获取工作，但总体讲获取难度在增加，特别是《生物多样性公约》生效后，许多国家开始制定针对本国植物遗传资源保护的法律法规，限制了遗传资源的出口和交换。另外，由于世界各国对遗传资源获取和利益分享缺乏有效的机制和操作程序，特别是国际社会在遗传资源的国家所有权、遗传资源的获取方式与条件以及遗传资源利益的公平分享等问题上还存在较大的争议和分歧，这在一定程度上限制了遗传资源的广泛获取和交换。

很显然，中国从国外获取遗传资源的数量越来越少，特别是对那些非起源中国的植物遗传资源的获取更加困难。为促进植物遗传资源的有效获取，中国正在研究加入《条约》多边体系的可行性，以便争取更多的资源获取机会；同时中国将加强地区和双边合作，进行遗传资源交换，并通过联合考察、鉴定，在合作伙伴之间开展遗传资源共享。

7.3 植物遗传资源利益分享现状及存在的问题及对策

植物遗传资源利益是通过开发产品并商业化后才能实现。利用遗传资源培育出新品种，可以创造巨大的经济价值，如中国的育种单位利用“矮孟牛”小麦种质，培育出了近 20 个小麦新品种，在生产上发挥了重要作用，产生了数百亿元的经济效益。遗传资源不但能创造巨大的经济价值，而且在丰富生物多样性、保护生态环境、传承民族文化等方面起着无法估量的作用。

在中国，植物遗传资源归国家所有，政府相关部门和科研机构行使遗传资源管理权，但植物遗传资源的直接受益者是农民，因为利用这些遗传资源培育的新

品种增加了产量，改善了品质，增加了农民收入。农家品种和野生近缘种对现代品种的培育发挥了巨大作用，从事保护这些地方品种和野生近缘种的农民，可以通过科技信息、培训、经济补偿、新品种种植等方面获得利益。

在中国现有法律法规中，尚未涉及遗传资源开发所获得利益的分享机制。因此，有关遗传资源利益分享机制的形成都是自发性的，通常有两种形式：一是在大型合作项目中产生，合作各方通过签署协议，确定遗传资源提供者在利益分享中所占的比例，从而有效保证参与各方公平分享合作项目所产生的利益。二是在遗传资源提供者和利用者之间产生，通过双方签署协议，明确双方的责任和利益分享形式或比例。

尽管对利益分享机制进行了初步探索，但在运行过程中也存在许多困难，例如，现有植物遗传资源利益分享方面的规定大多是一些原则性的，不具备法律约束力和可操作性；许多情况下很难确定遗传资源的产品、商品化的程度、以及遗传资源在产品中所占的比例；遗传资源产生效益要经历较长时间，难以保障利益共享协议的有效性；有些遗传资源利用者不愿意反馈利用信息，很难追踪并分享产生的利益。

植物遗传资源获取和利益分享是植物育种的先决条件，也是农业可持续发展的根本保障。有关部门非常重视遗传资源获取与利益分享问题，正在积极采用措施改进遗传资源获取和利益分享现状。例如，完善相关法律法规和政策体系，促进植物遗传资源获取；制定有效的获取机制，使获取更加方便；政府继续加大投入力度，繁殖更新中期库植物遗传资源，为提供利用奠定基础；制定更加切实有效的利益分享机制，鼓励有关机构与外国进行对等交换，反馈资源利用信息，实现商业利益分享。

7.4 农民权利的落实情况和建议

国际社会十分重视农民权利，旨在承认农民在保护粮食和农业植物遗传资源过程中做出的巨大贡献。《生物多样性公约》积极寻求解决农民权利的办法，尤其是要解决原生境植物遗传资源获取和利益分享方面的突出问题，《粮食和农业植物遗传资源国际条约》以法律条文形式正式确认了农民权利的地位，强调在国际和国家层面上落实农民权利。通常情况下，农民权利主要体现在如下几个方面：（1）保护与植物遗传资源有关的传统知识；（2）公平分享由利用植物遗传资源

所获得的利益；（3）参与国家关于植物遗传资源保护和利用的决策活动；（4）保存、繁殖、销售地方品种的权利；（5）利用育种家的品种和从遗传资源保存中心获取遗传材料的权利。

中国在落实农民权利方面尚处于初级阶段，虽然认识到保护农民权利的重要性和必要性，也在积极研究可能的政策和措施，但目前还面临很多困难：一是尚未通过法律对农民权利给予确认，也就没有实施的法律依据；二是农民权利理论发展尚不成熟，对农民权利的主体、范围、内容和实现模式尚不明确。中国是发展中国家，也是农民权利的积极支持者。中国政府正在考虑通过植物遗传资源和传统知识的保护和利用，使农民权利得到真正落实。

为积极推进农民权利的落实，建议：一是把农民权利纳入植物遗传资源管理范畴；二是考虑制定或修改现有法律，正式确认农民权利，并对农民权利的主体、范围、内容和实现模式做出明确的规定；三是建立可行的生态补偿制度，促进原生境植物遗传资源保护，维护当地农民的权益。

第八章 粮食和农业植物遗传资源管理对粮食安全和可持续发展的贡献

粮食和农业植物遗传资源是人类社会生存发展的战略性资源，是提高农业综合生产能力，维系国家食物安全的重要保证，因此通过对粮食和农业植物遗传资源的管理，发掘和利用资源中蕴藏的优异性状、优良基因，促进植物育种、科学研究和农业生产快速发展，为中国乃至世界粮食安全、经济发展、消除贫困和农业稳定性等方面做出积极贡献。

8.1 对中国粮食安全的贡献

粮食和农业植物遗传资源管理为中国粮食安全做出了举世瞩目的贡献，特别是 1978 年改革开放 30 年来，中国直接利用粮食和农业植物遗传资源培育农作物新品种、新组合达 6000 多个，其中通过国家审定的农作物品种 2297 个，包括杂交水稻在内的粮、棉、油等主要农作物品种在全国范围内更换了 4-6 次，每次更换都增产 10％以上。据专家估计，作物产量每增加 10%，可使日收入低于 1 美圆生活水平的贫困人群减少 6%～8%。中国粮食和农业植物遗传资源的有效利用，不但对增加农作物产量、提高农产品品质、优化种植业结构发挥了重要的作用，而且在增加农民收入、保障农产品供给和减少贫困等方面也发挥了巨大作用。

据统计，从 1949 年到 2007 年，中国粮食单产从每公顷 1050 公斤提高到 4400 公斤，粮食总产从 1132 亿公斤提高到 5015 亿公斤，分别增加了 4.2 倍和 3.8 倍，其中水稻单产从每公顷 1890 公斤提高到 6383 公斤；小麦由每公顷 630 公斤增加到 4765.5 公斤；玉米杂交种的推广面积已占玉米种植面积的 70%～80%，单产由每公顷 1335 公斤提高到 5393 公斤，目前我国主要农作物良种覆盖率达到 95%以上，良种在粮食增产中的贡献率接近 40%。由此可见，粮食和农业植物遗传资源是中国乃至世界粮食安全的战略资源。

8.2 对中国农村经济发展的贡献

中国粮食和农业植物遗传资源的保护和利用，促进了以农产品加工业为依托的农村经济的较快发展，不但提高了农产品质量、实现了农产品增值、增加了农民收入，还吸纳了农村剩余劳动力。2000 年以来，农产品加工业的产业结构和产品结构得到逐步调整，形成了以粮油、果蔬、畜产品和水产品加工为主导行业

的农产品加工产业格局。其中，食品工业比重上升，2005 年食品工业占农产品加工业产值的比重达到 50%。产品结构呈现多样化趋势，产品附加值不断提高，主要农产品深加工比例达到 30%以上，逐步由初加工向深加工转变。

中国农产品加工业产值年均增长近 15%，2005 年达到 4.2 万亿元，据专家预测，2010 年中国农产品加工业产值将突破 7.0 万亿元，到“十一五”末农产品加工业产值与农业的产值之比超过 1.5∶1。

一些以农业为主的县市，农产品加工业的税收对本级财政的贡献率已达到 70%，通过建立“公司+基地+农户”、“公司+中介组织+农户”、“公司+村委会+农户”等多种利益联接机制，增加农民收入。目前，全国年销售收入 500 万元以上的农产品加工企业 7 达万多家，其中国家级农业产业化龙头企业 580 多家，带动农户 8726 万户，占全国农户总数的 35.2%，参与产业化经营的农户比普通农户每户年平均增收 1300 多元。农产品加工业的发展必将对粮食和农业植物遗传资源提出更高的要求。

8.3 对消除贫困的贡献

中国为解决目前 6400 余万人口的贫困问题，采取的重要措施之一就是通过对粮食和农业植物遗传资源的管理，发挥重要经济作物和特殊地区特殊作物的作用，在中国西部的青海、甘肃、贵州、云南等贫困地区，大力发展适合当地种植的经济作物，收到了良好的效果。

青海海东地区实现了从原来的粮食作物、经济作物二元结构向粮食、经济、林草业、畜牧业四元结构转变。贵州毕节地区变林粮争地为林茂粮丰，全区粮食产量从 1999 年退耕前的 222 万吨提高到 2007 年的 247 万吨，增长了 11.4%，农民人均纯收入年均增长 12.4%。云南澜沧江流域的西双版纳和思茅地区，建成热带水果和经济作物种植与加工示范工程，年创产值将达 3750 万元，使本地区 2 万农民脱贫，10 万农民间接受益。甘肃文县和武都县充分利用社区山地、林地资源，大力发展药材、茶叶等劳动密集型产业和农产品加工业，提高产品附加值，使农户从中得到实惠。海南三亚地区大力发展槟榔、橡胶、椰子、芒果等特色种植业, 提高经济作物在种植业中的比重，初步实现了脱贫致富。

据统计，经济作物和特殊地区特殊作物的经济效益得到较快发展，1949 年到 2007 年，棉花经过 6 次品种更新，单产由每公顷 375 公斤提高到 1335 公斤，

尤其是具有自主知识产权的抗虫棉，其播种面积由 1999 年占全部棉花播种面积的 7%增长到 2006 年的 82%，累计推广超过 1100 万公顷，节约农药 4.5 万吨，受益农户超过 3000 万户。通过“三系”配套选育的“秦油 2 号”油菜，平均单产达到每公顷 1830 公斤以上。利用高抗青枯病花生种质育成了一大批高抗青枯病丰产品种，已在全国推广，每年约增加收益 2.0 亿元。以湖南辣椒地方优异资源作亲本，育成湘研 1～10 号系列品种，在全国 30 个省市累计推广 6.5 万公顷。云南黑籽南瓜用作黄瓜嫁接砧木可增产 30%～50%，已在全国推广 1.4 万公顷。20 世纪 90 年代中期以来，推广的新台糖系列甘蔗品种，高产、含糖量高，使广西主产区甘蔗的平均单产水平达到每公顷 67.5 吨，为中国食糖的供求平衡做出了贡献。

8.4 对农业稳定性的贡献

粮食和农业植物遗传资源是为生产提供优良品种的宝库，掌握的粮食和农业植物遗传资源越多，就更有可能选择到适宜的生产品种，并可以科学合理地进行品种区划和品种搭配，抵御各种灾害，促进农业稳定性发展。例如：中国利用优质小麦品种小偃 6 号作直接或间接亲本，培育优质、抗病、高产小麦新品种 53 个，累计推广面积超过 2000 万公顷，增产粮食约 80 亿公斤，创直接经济效益超过 100 亿元。利用优异种质资源培育的超级杂交稻，2000-2005 年累计推广 1400 万公顷，增产稻谷 125 亿公斤。

云南农业大学开展了利用生物多样性控制病虫害的研究，发现农作物品种多样性控制病害的基本规律，研发了水稻、玉米、马铃薯、小麦、蚕豆作物多样性控制主要病害的 5 项专利技术，并进行了大面积推广应用，2003-2005 年在云南、四川的累计应用面积已达 240 多公顷。

8.5 对科技创新的贡献

中国政府还建立了国家植物种质资源共享平台，促进粮食和农业植物遗传资源的共享和利用。通过信息网站、资源田间集中展示、优异资源通讯、资源目录等多种形式，推动种质资源实物共享和信息共享，提高了粮食和农业植物遗传资源的利用价值和效益。2001-2007 年，已向全国 2650 个单位提供了 13.2 万份次的粮食和农业植物遗传资源，用于新品种选育、生物科学研究和农业生产等，促进了中国的农业科技创新，并产生了巨大的社会经济效益。

粮食和农业植物遗传资源对农业科技创新的重大贡献还体现在超级稻、矮败小麦、转基因抗虫棉和杂交大豆等新品种培育方面。其中超级杂交稻在充分利用野败胞质和改良野败型不育系的同时，充分发掘新的不育胞质源，为中国杂交水稻在理论研究、品种培育、技术集成等方面奠定了基础。矮败小麦是利用中国特有太谷核不育小麦种质资源和矮秆小麦种质资源，通过染色体工程创制而成的小麦育种新种质和育种新技术。利用这一新种质和新技术可使数十个小麦亲本的优异基因聚合到一个新品种之中，从而提高新品种的产量、品质、抗病虫和抗逆性，实现了高产、优质、抗性三者的有机结合，提高了育种效率，为农业生产提供不同需求的小麦新品种。中国育成的世界上第一个大豆杂交种“杂交豆 1 号”，比对照品种增产 21.9%。转基因抗虫棉实现了抗棉铃虫、抗蚜虫的有机结合，处于世界先进水平。

8.6 国家需求与发展重点

根据专家预测，到 2020 年中国人口将达到 14.5 亿，需增加粮食 9000 万吨。加强粮食和农业植物遗传资源的管理，培育高产、抗病虫、抗逆境、高效利用水肥的植物新品种是解决问题的有效的途径。

未来的发展重点是加强粮食和农业植物遗传资源管理的能力建设，立足于现有工作基础，近中期目标与长远目标相结合，集中全国优势力量，统筹规划，开展植物遗传资源基础性工作、基础研究和应用基础研究。大规模开展种质资源深入鉴定与评价，发掘具有重大应用前景的新基因，创造突破性新种质，为植物育种和农业可持续发展奠定稳固的基础。

Preface

Trusted by the Ministry of Agriculture in 1996, the Former Institute of Crop Germplasm Resources of the Chinese Academy of Agricultural Sciences (CAAS) organized experts to write the first report on the State of Plant Genetic Resources for Food and agricultural in China. It has provided important material for the State of the World's Plant Genetic Resources for Food and Agriculture and has been appreciated by Food and Agriculture Organization of the United Nations (FAO). The State of the World Plant Genetic Resources for Food and Agriculture was adopted during the Fourth International Technical Conference on Plant Genetic Resources, which was held in Leipzig, Germany in 1996, and in this conference, the Global Plan of Action for the Conservation and Sustainable use of Plant Genetic Resources for Food and Agriculture (GPA) was formed and adopted. GPA identified 20 priority actions on conservation and sustainable use of plant genetic resources with the purpose of encouraging all countries in the world to implement it in all round way through national behavior and international cooperation, promoting safe conservation and sustainable use of plant genetic resources in the world, and making contribution to solve food and poverty problems in the world.

China is rich in plant genetic resources for food and agriculture. In the past decade, in order to effectively implement GPA, China has taken a series of practical and effective measures and has made great progress. China has made outstanding contributions to plant breeding and food security in the world. In order to comprehensively summarize the achievements we made in conservation and sustainable use of plant genetic resources and analyze and evaluate the challenges and requirements we faced, we have organized some experts to write second report on the State of Plant Genetic Resources for Food and Agriculture in China , thus it may provide some information to Food and Agriculture Organization of the United Nations for preparation of the second State of the World's Plant Genetic Resources for Food and Agriculture.

Second report on State of Plant Genetic Resources for Food and Agriculture in China is written with the requirements proposed by FAO and the guideline for country report. It has been also received the financial support from FAO. The Ministry of Agriculture has attached great importance to the work on writing country report and has established leading group and expert advisory committee. It has organized scientists to make wide investigation. By collecting information, conducting scientific analysis and summing up, we have finally completed the formal report.

The Second report on State of Plant Genetic Resources for Food and Agriculture in China is consisted of abstract, introduction and text. The report has comprehensively reflected the new progress we made in safe conservation and sustainable use of plant genetic resources in China and made new requirements for future development. It has an instructive significance in promoting the implement of Global Plan of Action for the Conservation and Sustainable use of Plant Genetic Resources for Food and Agriculture in China and solving the problems in safe conservation and sustainable use of plant genetic resources both in China and the world.

June 2008， Beijing

Abstract

Over a decade, the Chinese government has attached great importance to the conservation and utilization of plant genetic resources for food and agriculture (*PGRFA*). According to more than 20 priority projects described in the Global Plan of Action for the Conservation and Sustainable use of PGRFA, the Chinese government has formulated and perfected a series of regulations and laws. It has strengthened the management for plant genetic resources. Through training and popularizing science knowledge, it has raised the public awareness. Through the international cooperation and establishment of collaborative network, it has promoted the exchanges of information, scientists and plant genetic resources. Through the national programmes and projects, the protection system for plant genetic resources has been established and perfected, it has realized the objectives on safe conservation and sustainable use of plant genetic resources, and has played a great role in plant breeding and food security both in China and in the world.

1. We have made a systematic survey and catalogue for main grain crops and wild species of crops. We have established 86 *in situ* conservation sites, including wild rice, wild soybean, wild relatives of wheat, wild vegetables, etc., In addition, 30 *in situ* conservation sites have been put in plan for construction. Rapid extinction of wild plant genetic resources has been checked effectively.

2. We have established and perfected a long-term national gene bank, one national duplication gene bank, ten medium-term national gene banks, 29 medium-term gene banks at provincial levels and 32 national gemplasm resources nurseries (including two in vitro seedling banks). In addition, 7 germplasm resources nurseries are in building. Thus, a sound system for conservation of national plant genetic resources has been basically formed. It can conserve 391,919 accessions of plant genetic resources for a long time. Compared with 1996, it has increased by 32,956 accessions.

3. We have multiplied and regenerated 286,604 accessions of plant genetic

resources. They have enriched the medium-term gene banks and significantly increased the distribution and supply ability of plant genetic resources. Only in 2001-2007, 132000 accessions of germplasm resources were provided to 2650 units in China.

4. With the investment of 100.8million Yuan Renminbi from the State, the national key project on “crop gene resources and gene improvement” was established in 2003, it has provided a condition platform for identifying genotypes of plant genetic resources and exploring new genes which have an important perspective for application.

5. Through deeper characterization and evaluation of plant genetic resources, a set of excellent germplasm resources have been discovered and a number of new plant varieties have been developed and been used in production. They have greatly raised the use efficiency of plant genetic resources. Meanwhile, the Chinese Government has attached great importance to the utilization of diversity of plant genetic resources. Through intercropping and rotation between different kinds of crops and intercropping same crops with different varieties, it has protected the diversity of varieties and reduces the damages caused by diseases, pests and weeds.

6. By strengthening the management for plant genetic resources, it has realized the objectives of sharing the plant genetic resources in the country and expanding the exchanges with foreign countries, and has made great contribution to keep food security both in China and the world, promoted sound and rapid development of national economy, reduced the poverty, and increased the farmers’ income.

Although China has gained remarkable achievements in conservation and utilization of plant genetic resources, we still face a number of challenges. China needs to strengthen the cooperation with other countries and international organizations, needs to obtain plant genetic resources and relevant technologies from abroad, and needs to continue the survey, exploration and collection of plant genetic resources, especially for wild plant genetic resources and old land races which are grown in remote areas, needs to further establish and perfact conservation systems for plant genetic resources and provide all round protection for plant genetic resources in our coubtry. So we should systemetically identify and evaluate the plant genetic resources we have conserved and provide them for the use by breeders. We should expand genetic base of breeding materials. Only thus, can China sufficiently share the resources and benefits and further improve the utilization efficiency of resources.

Introduction

China is situated in the eastern part of Asia, it is bordered by several countries: Korea in the east; Vietnam ,Laos, Burma in the south，India, Bhutan , Nepal, Pakistan, and Afghanistan in part of the southwest and west， Russian, Kazakhstan, Kyrgyzstan, Tajikistan in the northeast and the northwest and Mongolia in the North. China is near neighbour to Japan, Philippines、Malaysia, Indonesia、Brunei. China has an area of about 9.6million square kilometers. It is the biggest country in the Asia.

High in the west and low in the east, China has a varied topography, among which, mountainous regions cover 33%, plateau 26%,. Basin 19%, plain 12%, hills 10%. Main rivers include Yangtze River, Yellow River, Zhu Jiang, Heilongjiang River, Huaihe and Haihe, etc.. All the rivers flow into the Pacific Ocean. With the vast territory, China stretches across the tropical, subtropical, temperate and frigid zones. Most of the area are located in the north temperate zones and subtropical zones and controlled by the monsoon climate of east Asia. Because of varied topography, great difference of elevation and long distance between inland and sea, China has varied climates. There are great differences in annual rainfall among different areas in China. The annual rainfall could get over 1500mm in the coastal areas of southeast China, and gradually get some decreases in the inland areas, with that in northwest under 50mm.

China is a country with a very large population. According to the statistics conducted in January 2005, the population in mainland (except for Taiwan Province, Hong Kong and Macao) reached 1.3 billion, accounting for 22% of the total population in the world. The Chinese people are mainly concentrated on east and central parts of China, fewer in the West.

The cultivated area in China is about 120 million ha, planting area for crops covers 150 million ha，of which, the sowing area of grain crops is about 100 million ha.，the total production of grain crops was 501.5 million tons in 2007. China is the country whose intercropping and relay intercropping area is the largest in the world. The multiple crop index is about 160%. In lower reach of Yangtze River, rotation system of rice - wheat or double cropping of rice- rape have been practiced. From the north of Yangtze River northward up to the low reach of Yellow River where is the main growing area for winter wheat, cotton, maize, peanuts, soybean in China，two-crops a year system or three-crops two years system is practiced, the main patterns are that wheat and potato intercrop maize or groundnut intercrops sesame and sorghum intercrops black bean. Over the last decade, the protected cultivationhas been developed rapidly in China. The vegetables can be planted with multiple crops a year.

The distribution of crops in China is region specific. The Northeast is the centralized growing areas of maize, soybean, rice, sorghum, sugar beet, where only one-crop a year system can be generally practiced. The Northwest is in the arid and semiarid area, the main crops there are spring wheat, maize, millet, highland barley, potato, melon and fruits, with one-crop a year system. The plain area of north China is the major growing area of wheat, maize, soybean, etc. with two-crops a year system or three- crops two year. The middle and lower reaches of the Yangtze River are the major centralized growing areas of rice, cotton, rape, silk and tea. Guangdong, Guangxi, Fujian and some areas of Yunnan are in the subtropics and tropics, with three crops a year. These areas teem with rice, sugarcane rubber, coffee, coconut, oil palm, and other tropical fruits.

Rapid development of agriculture in China mainly relies on the policy on supporting agriculture and benefiting the farmers and increasing input for capital construction on farmland and scientific progress. Intensifying conservation and utilization of plant genetic resources，developing new varieties with high-yielding, good quality, disease resistance and high adaptabitity for heavy fertilizer and water will play an important role in sustainable increase of yield and production of the crops and ensuring food security.

The Ministry of Agriculture is a government body which mainly governing agriculture in China. The departments of agriculture at provincial and county levels are local government bodies for agriculture. The plant genetic resources belong to the country and are governed by the Ministry of Agriculture. The Chinese Academy of Agricultural Sciences (CAAS), the Chinese Academy of Tropical Agricultural

Sciences (CATAS) and the Chinese Academy of Fishery Sciences are national agricultural research organizations. Each province and prefecture has its own academy or institute of agricultural sciences. Trusted by the Ministry of Agricultural, the Institute of Crop Sciences of CAAS is responsible for organizing, coordinating, management and implementation work on exploring, collecting, introduction, exchanging, identification, evaluation, safe conservation, distribution and utilization of plant genetic resources for food and agriculture in China.

In China, the work on developing new crop varieties is conducted in agricultural research institutes or colleges, state or private seed companies. All varieties developed must be examined and approved by Crop Variety Approval Committee at national and provincial levels and should be planted in limited areas. Improved varieties should apply the protection for new plant varieties. By transfer the rights of new variety, it shows that we possess the intellectual property rights. The Ministry of Agriculture and seed management stations at provincial and municipal levels are responsible for the management of new crop varieties. Seed-industry enterprises are responsible for seed production and business.

Chapter 1 Diversity

China is vast in territory. Topography in agricultural zone is quite complex， plains, hills, mountains areas, high plateaus, rivers and basins crisscross, with different kinds of soil types. The altitude is quite different, some areas with the characteristics of “vertical farming”. The climatic conditions are extremely diverse， with frigid, temperate, sub-tropical and tropical zones. There are humid and semi-humid area，and arid and semi-arid areas. China has a long history in agriculture. The hardworking Chinese people have domesticated and cultivated a large number of grain crops and agro-plants, it has made China become one of eight origin centers of cultivated plants in the world. Meanwhile, in different kind of ecological environments, and by natural and artificial selection for a long time, different kinds of landrace and diverse varieties have been formed. They have made up rich and varied plant genetic resources at species, type and variety levels.

1.1 Overview of Crop Species Diversity in China

According to preliminary statistics that about 10000 species are closely associated with the agriculture and human life in China. At present, more than 661 species (excluding forest) are cultivated in China, of which, grain crops are about 35, 74 for cash crops, about 64 for fruit trees, over 163 for vegetable crops，78 for feeding crops and green manure crops ,114 for ornamental plants (flowers)，133 for medical crops. In the taxonomy, these cultivated crops contain 1356 cultivated species and 2172 wild relatives, of which, food crops include 103 cultivated species and 311wild relatives, cash crops include 98 cultivated species and 454wild relatives, fruit trees include 149 cultivated species and 420 wild relatives, vegetable crops include 222 cultivated species and 150 wild relatives, feeding crops and green manure crops include 196 cultivated species and 353 wild relatives, ornamental plants include 588 cultivated species and 484 wild relatives.

For cultivated crops originated in China, the scientists both in China and abroad have conducted a wide range of survey and textural research, and the common view is that about 300 species of crops originate in China.

1.2 Status of Diversity of Main Crops

Overall, in the past 50 years, no great changes occurred for the species of main crops in China. The crops planted in China for a long time are dominated by grain crops. After the 1980s of twenty century, since China has promoted the policy for adjustment of agricultural structures, the planting areas and production of cash crops and horticultural crops have increased to some degree.

The staple grain crops in China include cereal crops, legume crops, tuber and root crops, etc., of which, cereal crops account for 84.3％. Rice, maize and wheat are most important crops in China. The sowing area accounted for 35.0%, 32.3% and 27.9% of total areas of cereal crops respectively in 2006.They have significant impacts on food security and socio-economics in China. Rice is mainly planted in vast areas of southern parts of China and some parts of the Northeast China. Maize is mainly planted in a narrow belt from northeast to southwest of China. Wheat is mainly cultivated in the areas of Yellow River, Huai River and Hai River. Maize is a crop both for food and feed. In recent years, the maize production has developed rapidly; its total production has exceeded wheat production and ranked second in China. For edible legume crops, the main crops are common beans which are planted in northeast, northwest and southwest parts of China, and faba beans which are planted in Jiangsu and Zhejiang provinces. The cultivated areas for both crops are over one million ha respectively. The cultivated areas for potato and sweet potato rank seventh position and ninth position respectively. In China, potato is mainly grown in northern part of China, but sweet potato is mainly grown in the South. Potato is used as vegetable and sweet potato as feed crops. Both crops may also be used as food.

Cash crops include oil bearing crops, sugar crops, fibre crops, recreation crops, etc. Soybean which is mainly planted in northeast parts of China and the areas of Yellow River, Huauhe River and Haihe River, and rape which is grown in southern parts of China are two major oil bearing crops. They are only after rice, maize and wheat in cultivated areas. In addition, peanut is also an oil-bearing crop which covers a large area in China. Its cultivated area ranks eighth position in all crops. Cotton occupies sixth position in cultivated areas. About 93％natural fibres in China come from cotton which is planted in Yellow River, Huaihe River, Haihe River, Yangtze River valley and Xinjiang areas. The cash crops with cultivated areas over one million ha include tobacco, sugarcane, tea and sunflower. The planting area of Sugarcane which is mainly cultivated in tropical areas in China accounts for 88.5％of that of sugar crops. Tobacco and tea planted in the South are also major cash crops in China. Sunflower is distributed widely in China. It is mainly used as oil-bearing and edible crops.

Horticultural crops are abundant in species. Although the cultivated areas are less than that of grain crops, the production value is relative higher. They occupy important positions in adjusting industrial structure and improving people's diet structure. In the fruit trees with planting area over one million ha, the citrus which are planted widely in the South rank the first position, it is also a crop which occupies tenth place in all important crops, including mandarin orange (Citrus reticulata), tangerine (Citrus reticulata Blanco), orange（Citrus sinensis）, pomelo shaddock（Citrus grandis Osbeck）, cumquat, lemon. The following are apple, plum and pear which are mainly planted in the North China. In the vegetable crops with planting area over one million ha, Chinese cabbage occupies the first place which is planted widely in the country. Watermelon ranks second, and after that are radish, cucumber, cabbage, tomato, eggplants and asparagus.

For the main crops mentioned above, by intensifying the work for variety improvement, we have developed some new varieties with high-yielding and wide adaptability. Thus, variety numbers used in production will show sharp decrease for a long period in their history, and fewer varieties will cover large cultivated areas. For instance, there were 46000 rice varieties planted in China in the 1940's, but now the rice varieties used in production are less 1000, of which, only about 300 varieties with cultivated areas over 10000 ha. for each are planted, and half of them are hybrid rice. In the 1940's, over 13000 wheat varieties were planted in China, of which, over 80％ were local varieties. But in the end of twenty century, only 500～600 varieties were planted in production, and over 90％ were bred varieties.

It needs to note that in the past decade, as influenced by changes of external environmental factors like market requirements, diet culture and the improvement of people's life standards, the importance of some crops has also changed. For instance, maize once is the third important cereal in China. But now it has became second one. With the people's life standards improved and the increase of demands for meat and milk, maize has become an important feed crop.

1.3 Status of Diversity for Secondary Crops and Underutilized Crops

In grain crops, secondary crops and underutilized crops include millet (mainly planted in the northern provinces and autonomous regions), Broomcorn Millet (Panicum miliaceum L) and Proso Millet (mainly grown in the North), barley (mainly grown in the Northwest and the Southwest), buckwheat（mainly grown in Shanxi and the southwest）, oat, triticale, rye, mung bean, pea, lentil, etc..Millet once is one of major crops in north part of China, especially in the 1950's and before, it occupied an important position in grain crops in the North, but now, it has become a marginal and upland crop，the cultivated area reduced to less one million ha.. Buckwheat is distributed widely in China. Since it is short in growing period, most of them are used to prepare against natural disasters or as the crops planted in fallow season. China has different kinds of legume crops. Pea, mung bean and red bean have a long history in cultivation and they distributed widely. The cultivation history for cowpea, lentil and potato bean is over thousand years. Cassava is mainly grown in tropical areas of southern parts of China. As an important energy resource crop, it develops rapidly in Hainan and Guangdong Provinces and Guangxi Zhuang Autonous Region.

In cash crops, the secondary crops include oil-bearing crops, such as sesame, flax for oil, castor-oil plant (Ricinus communis L), and safflower，sugar crop, sucu as sugar beet, recreation crop,such as coffee, and crops used as raw materials for industrial processes, such as sorghum, hop and rubber. Sorghum was one of main crops in northeast and north part of China before the 1950s. But now it has gradually become the raw materials for making wine. The cultivated areas decreased significantly. Bast fibre crops are secondary and underutilized ones in China. Ramie is always used as raw materials for dress and clothes. Jute, Kenaf (*Kenaf Hibiseus Canabinus*), Abutilon (*Abutilon theophrastii* Medic), hemp, sisal, flaxare are used as raw materials for making rope and gunny-bags. Sugar beet is an important sugar crop which is planted in northeast part of China. Mulberry is an old crop which is planted in the southern part of China. Coffee is an important secondary crop in Hainan Province.

In vegetable crops, secondary crops and underutilized crops include leafy vegetables， such as celery, spinach, lettuce, edible amaranth, water spinach, garlan chrysanthemum, white malabar nightshade (Basella sp). Cucurbita and fruit vegetables incude hot pepper, cantaloupe, pumpkin, vegetable marrow, Chinese wax gourd, sponge gourd, bottle gourd (*Calabash gourd*) and balsam pear. Legume vegetables include bean, asparagus bean, haricot, sword bean. Although mustard, turnip, non-heading Chinese Cabbage（*Brassica campestris* ssp．chinensis Makino）, Broccoli (*Brassica oleracea* L.,Ltalica Group), cabbage mustard (*Brassica capitata* L. var. alboglabra (L. H. Bailey) Musil) belong to secondary vegetables, they have been planted widely. Root and tuber vegetable crops include ginger, yam, elephant's foot, Canada potato (Helianthus tuberosus L.). Ginger is an important condiment vegetable，it is also a competitive product in the Chinese export vegetables. Elephant's foot is an important starch source and also a vegetable crop. Spice and condiment vegetables include green onions, ginger, garlic, fennel, *Pericarpium Zanthoxyli,* star anise. Perennial vegetables include lily flower (Hemerocallis citrina Baroni), lily, medlar (Lycium barbarum L), Asparagus, Bamboo Shoots. Root vegetables include carrot. Aquatic vegetables include lotus root, jiaobai (wild rice shoots), water chestnut, arrowhead, water caltrop, water chestnut (Trapa biconis L.) and water shield. Although the vegetables mentioned above have limited areas in planting, their planting scope is quite wide and they have become indispensable vegetables on the table.

The fruit trees which the cultivated areas are less one million ha include persimmon, peach (including nectarine), grape, mango, banana, walnut, chestnut, pineapple, betelnut, oil palm, coconut, apricot, Chinese date, papaya, cherry, fig, strawberry, olive. In the North, peach and apricot have different kinds of species. Hawthorn, Chinese date and Chinese gooseberry distributed widely in China, with many wild species. Strawberry, grape, persimmon, pomegranate are common fruits. Banana has diverse varieties with large amount of production. Lichi, longan, loguat, zuccmume (*P. mume* Sieb. et) and waxberry are origin in China. Coconut, pineapple, papaya, mango are mainly planted in Hainan and Taiwan. Among the dry fruits, walnut, chestnut, filbert are planted widely in mountain areas.

1.4 Status of Diversity for Wild Relatives

China is one of original centers for eight main crops in the world, it not only has different kinks of grain crops and cultivated plants for agriculture，but also has many wild species and wild relative plants. According to statistics that 35000 accessions of wild plant genetic resources for agriculture have been collected and conserved, of which there are about 20000 accessions of wild relatives for grain crops, 9700 accessions of wild relatives for oil-bearing crops, 3000 accessions of wild relatives for fruit trees, mulberry and tea, 2300 accessions of wild relatives for bast fiber crops, sugarcane and pasture grasses.

For wild relatives of grain crops, wild rice and wild wheat have eleven genus, wild rice including *O.rufipogon*, *O.meyeriana*, *O.officinalis and Leersia japonica* (Makino) Honda, wild wheat including Aegilops, Roegneria, Elymus, Roegneria, Agropyron. Wild barley has two species, including two rowed barley（*Hordeum vulgare* ssp. *spontaneum*）and six rowed barley (*H. vulgare* ssp. *agricrithon*). Wild relatives of millet include foxtail millet (*Setaria italica*). Wild buckwheat has perennial buckwheat (*F.esculentum* Moench) and Tartary buckwheat *(F.tataricum*).and annual buckwheat (*F.esculentum* Moench) and Tartary buckwheat (F.tataricum).. Other wild crop species include wild broomcorn millet, wild cowpea, wild red bean and wild mung bean.

Oil bearing crops include wild soybean, wild rape, wild leaf mustard type rape and *Pedicularis grandiflora* Fisch. Wild soybean has three species, i.e. annual species of *Glycine soja,* and perennial species of *G. tabacina* and *G. tomentella.* Among fibre crops, there are 8 kinds of wild ramie species, including white falsenettle (*Boehmeria* *clidemioides* Miq.), greenleaf falsenettle (*B.tenacissima*) and planetreeleaf falsenettle (*Boehmeri.tricuspis* (Hance) Marino). Wild jute includes *Corchorus.olitorius* L., *C .capsularis* L.and *C. acutangularis* L., wild Cannabis and wild abutilon, and wild flax (Linum stelleroides Planch) consists of perennial root flax (Linum perenne L.), drooping pod flax (Linum nutans Maxim) and wild flax (Linum stelleroides Planch.), etc. Wild relatives of sugarcane are Geshoumao, Banmao, Hewangba and Jinmaowei. Tea has 37 species, of which, only one third have been domesticated and become cultivated varieties. Mulberry tree has 15 species, of which, 11 are wild mulberry trees. Hop has a wild variety, which is widely distributed in Tianshan and Altai mountains in Xinjiang area.

Wild species and wild relatives of cultivated vegetables include Chinese chives, such as Luange tuber onion (Liliaceae, *Allium ovalifolium*), Taibai tuber onion (Liliaceae, *Allium prattii*), Cugen tuber onion, Qinggan tuber onion, Mongolia tuber onion, *Allium senescens* Linn, *Allium henryi*, *Allium funckiaefolium* Hand.-Mazz, *Allium ramosum* L.； Wild onion (*Allium* L.) consists of altai onion (A. altaicum Pall.)、*Allium galanthum* Kar. et Kir, *Allium prattii* C. H. Wright；The wild relatives of garlic (*A. sativum* L.) are wild garlic, *A.pallasii Murr., Allium roborowskianum, A.decipiens Fisch.ex Rome. Et Schult and A. fetisovii Regel.* Relatives of wild cucumber include sour cucumber (*Cucumis hystrix* Chakr).The relatives of wild hot pepper are Dashujiao and Yunnan Shuanlajiao. Wild species of aquatic vegetables include wild water dropwort, wild waterchestnut, wild thickculm spikesedge (*Eleocharis Plantagineiformis T*ang et. Wang), wild arrowhead (*Sagittaria* L.) and field mint (*Mentha haplocalyx* briq). There are many other wild species of vegetables. More than 500 species of wild vegetable crops are under the research, development and utilization, such as *Megacarpaea delavayi* Franch，*Pugionium cornutum* (L.)，*Orychophragmus violaceus*, *Shepherdspurse* Herb (*Capsella bursa-pastoris*)，*Capsicum frutescens* Linn., wild eggplant, *Physalis pubescens* Linn，purslane (Portulaca oleracea)，*Premna microphylla* Turcz.，*Chenopodium album* L, *Doellingeria scaber* (Thunb.)Nees, dandelion (*Taraxacum officinale)* , *Codonopsis lanceolata*, Plantain (*Plantago asiatica* L.) and *Eryngium joetidum* Linn.

Wild fruit tree resources are much abundant in China. Wild species of apple (*Malus* spp.) include Siberia crabapple (*Malus baccata* L. Borkh), pearleaf crabapple （*Malus prunifolia*）, Xinjiang crabapple (M. mill), Hupeh crabapple (*M. hupehensis* Pamp. Rehd.), Honan crabapple (M.honanensis Rehd) and Sievers apple (*M.seversii* （Ledeb.） Roem). Wild species of pear (Pyrus spp.) include birchleaf pear (*Pyrus betulaefolia* Bunge), Dusky pear (*Pyrus phaeocarpa* Rehd.), callery pear (*P.calleryana* Dcne) and ussurian pear (*P. ussuriensis* Marim). Twelve Wild species of hawthorn (*Crataegus* spp.) have been collected and conserved, and most of them have not been developed and used. Wild species of peach include david peach (*Prunus davidiana* Carr. Franch), Gansu peach (*P.kansuensis* Rehd) and smoothpit peach (*P.mira* Koehne). There are ten wild species of Chinese date (*Ziziphus* Mill.). Wild sour jujube can be found all over the north part of China. There are more than 20 wild species of grape (Vitis L), 50 wild species of persimmon (*Diospyros* L.) and 57 wild species of Chinese gooseberry (Actinidia Lindl.). Xinjiang and Tibet autonomous regions have found wild walnut (Juglans cathayensis Dode). In addition, there are also some wild species of apricot (*Prunus armeniana* L.), falsesour cherry (*Prunus pseudocerasus*), hairy chest (*Castanea* Mill.), filbert (*Corylus* L.), citrus (*Citrus* L.), lychee (*Litchi chinensis* Sonn.), loquat (*Eriobotrya* Lindl.) and longan (*Dimocarpus*Lour。).

However, the losses of wild relative genetic resources are very serious in China. For instance, there were originally 24 ecological sites for wild rice in Jinghong County of Yunnan Province, but in 2001, only one exists. Originally，there were nine populations of *O.rufipogon* in Dongxiang, Jiangxi Province., but by 2001, only two populations remained, although some artificial mesures have been taken. Since 2001， The State has established a series of *in situ* conservation sites, it has strengthened the protection of wild germplasm resources and checked to some extent the endangered trend of wild relatives.

1.5 Status of Diversity for Crop Varieties

At the levels of types and variety diversity, the crop genetic resources collected in China are dominated by local varieties which account for about 85%. But there are great differences among crops. Generally speaking, proportion of local varieties of major crops is less than that of secondary crops. This is because the staple crops have long histry in breeding and large number of them have been developed into elite varieties (lines)，but the genetic resources of edible legume, oat, buckwheat, sesame, pakchoi, radish, tea, mulberry and many fruit trees are dominated by local varieties. Therefore, the staple crops used in production are improved varieties, but local varieties of minor crops are still used in production. As the development of minor crops breeding, some local varieties have become improved varieties or have been substituted by hybrids.

Rice is divided into Keng rice or Japonica rice, Hsien rice or Indica Rice, lowland rice and upland rice, early season rice, midseason rice and late season rice, non-glutinous rice and glutinous rice. Japonica and Indica have been divided into 50 varieties and 962 variants. Bread wheat in China has many kinds types, there are all together 127 varieties and it occupies the third position in the world. Maize in China can be divided into five races, i.e.North Dent race, race derived from cross between flint maize and Dent maize, north flint race with eight rows, race with broad and flat ear and south glutinous maize race. Soybean cultivars can be divided into 480 groups of 7 types in China. According to the sowing season, they could be divided into spring soybean in the North, summer soybean in Yellow River and Huaihe River areas, spring soybean in Yellow River and Huaihe River areas, summer soybean in Yangtze River area, spring soybean in Yangtze River area, spring soybean in the South, autumn soybean in the South and winter soybean in the South.

The feature of local varieties used in production is that most of them are cultivated in remote mountainous areas where not only large numbers of varieties are planted, but also large numbers of crops with different kinds of types are grown there. The main reasons for farmers to keep growing local varieties are: 1. The improved varieties are not adaptive to local ecological conditions, especially to areas with cold climate, dry or flooded areas and the areas with saline alkali soil, poor soil or acid soil；2. Some local varieties possess excellent stress resistance or disease resistance or high quality, and some have special utility values, for instance, the purple glutinous rice has a certain pharmaceutical effects.

Local varieties planted in production have played an important role in food supply at local areas. For example, Local rice variety Heinuogu is still planted in some parts of Yunnan Province. Local fragrant rice varieties is really appetzing，these varieties include Yunnan fragrant rice, Guizhou fragrant rice, Yangxian fragrant rice. The black and purple rice varities with black, purple or brown colour on surface of their grains have a tonic effect to man’s body. The varieties are Purple rice from Yunnan, Black rice from Donglan, Guangxi, Black glutious rice and Yaxue glutious rice from Guizhou. Soft rice is a peculiar one in Yunnan Province, its quality is between the glutinous rice and non-glutinous rice. The cooked rice is soft, sweet, tasty and refreshing after having it. Kermes rice has been cultivated in Hebei Province over 200 years. Some traditional quality rice like Shuiputao, Babao, Simiao are still planted in Shandong, Anhui, Henan, Hubei, Guangdong, Yunnan and Jiangsu provinces. The local varieties of maize (Zea mays) are mainly grown in the remote mountainous areas where the production level is low. The major characteristics of these varieties are cold resistance, drought tolerance and early maturity, such as Xueyumi, Erhuangbaogu, Xiaohuangbaogu, Baituanke, Erjizao, liushiri, etc. ”Hongbaogu” is still planted in Yunnan Province, and used as raw material to make wine. In addition, glutinous maize is a peculiar maize genetic resource to China which is planted widely in southwest provinces and autonomous regions. China now has more than 1300 accessions of local glutinous maize varieties, the major ones are Tengchong Nuobaogu, Xinping Bainuo, Yishannuo, Huasinuo, Linggongbainuo, Pinglinuoyumi, etc. Silu Nuoyumi which has four rows per ear is still planted in some areas of Yunnan Province. In some popularized varieties of other grain crops, local varieties are still main ones in production, such as edible pulse crops, broom corn millet (*Panicum miliaceum* L.) and buckwheat (Fagopyrum esculentum Moench). Local barley variety Heiqingke is still planted widely in mountainous areas of Yunnan and Tibet.

In cash crops, many local varieties are remained in production. Local varieties of turnip type rape (Brassica juncea) and mustard type rape (B.chinensis) are very abundant. They have high adaptability to local conditions. The representative varieties in western plateau of China are Menyuan rape, Yili yellow rape, Xiao Riqi and Lintan Dahuangjie. Most leading varieties of ramie (*Boehmeria nivea* L. Gaud) are local varieties, such as Heipidou, Luzhuqing and Xiyelu. The leading local varieties of green ramie are Daqinggan, Zantianhui, Anxin and Erfuhan. The leading local varieties of hemp fimble (*Cannabis sativa* L.) are Huating hemp, Wuchang 40, etc. In addition, local varieties of tea and mulberry are still used in production.

Local vegetable varieties are very abundant. At present, a large amount of local vegetable varieties are planted in production. Local varieties of Glycine max (L.) Merr include Huangzidou and Wuyueban. Local varieties of Pakchio are Shanghai siyueman, Nanjing aijiaohuang, Nantong Maerduo, Wuta-cai and Zhoushan Heiyoutong. Local varieties of radish include Xinlimei, Dahongpao, Fuling Hongxinluobo，Weixian Qingluobo, Baliqiao luluobo. Local varieties of eggplants have Rongchang Wubangqie, Daminqie, Qingcui xiaoqiezi, Caoqingqie, Lupi-changqie, Shijiemei-qie, Liuye-qie, Qiye-qie, Gaogan zhusiqie and Moqie. Local varieties of hot pepper include Ganhonglajiao, Yunnan Xiaomijiao, Zhijinlajiao, Suiyang Chaotianjiao, Yuganlajiao and Qiubeilajiao. Local varieties of cucurbita vegetable include Banqiao White cucumber, Wuyexiang sponge gourd, Xiaogan Bottle gourd (calabash gourd), Baiyushuang sponge gourd, Zhuzhou Changbai balsam pear. Many local varieties of other minor vegetable crops are used in production, especially for main vegetative vegetables and perennial vegetables. Most of them are local varieties. Local varieties of bulb vegetable include Chishuigucong, Naguwancong, Zhangzhou-dacong, Bijie garlic, Ledu-zipi garlic, Pizhou white garlic, A-cheng garlic, Kaiyuan garlic, Caijiapo garlic, Baimaya garlic, Lasha baipi garlic, Wenjianghong Qixing, Ershuizao, etc. Local varieties of leek are Shouguang Dugenhong, Hanzhong-dongjiu and Yunnanpiecai. Local varieties of Chinese yam (Dioscorea batatas Decne.) include Sheyang Huaishanyao in Jiangsu, Kunming Huaishanyao, Lufeng Jiaobanshanyao, Yanzhou Huangniutuishanyao and Shuangpaoshanyao. Local varieties of lily flower (*Hemerocallis* sp) include Huaiyang lily flower and Quxian lily flower. Local varieties of lily include Taihu lily, Lanzhou lily and Longya lily.

There are about 140 species of fruit trees cultivated in China. At present, the fruits dominated by local varieties are pear, hawkthorn, aprocot（such as Ruantiao-jingxing, yingtiao-jingxing, Hami-xing）, chestnut, gingkgo, Chinese date（such as Baode Youzao, Yazao）, filbert, walnut, lichi, longan and loguat, etc. Well-known local varieties of pear include Huagai pear, Apple pear, Cuixiangmili, Tangshansuli, Yali, Jinhua pear and Xuehua pear. Local varieties of peach include Baihua, Fenghuayulu, Shenzhoumitao, Zhonghuashoutao and Feicheng peach. Local varieties of Chinese date include Lizao and Golden silk date. Local varieties of apple include Tailihong, etc.

1.6 Main Factors Influencing the Diversity

Up to date, China has also found some cases that since the varieties cultivated by farmers have lost their diversity. They have resulted in genetic vulnerability. For instance, in the mid-1960s to the mid-1970s, F1 and F2 single-cross maize hybrids we developed like Weier 156 and Danyu 1 were infected northern leaf blight disease and southern leaf blight, they caused the prevalence of northern leaf blight disease and southern leaf blight. In the late 1970s and the early 1980s, among the F3 single-cross maize hybrids, the hybrids with 525 as parent were infected seriously by dwarf mosaic disease, they caused rapid spread of dwarf mosaic disease. In the late 1980s, since F4 single-cross maize hybrids represented by Zhongdan2, Danyu 13 and Yandan 14 were in commercial production, bacterial wilt disease and spike rot disease were more serious. For F5 hybrids developed in the 1990s, some varieties were susceptible to gray leaf spot and curvularia disease. Since the improved wheat variety Bima 1 developed in the 1950-60s was used in commercial production, it resulted in the epidemics of wheat stripe rust caused by Race 1 of Puccinia striiformisf. sp. Tritici. By planting wheat variety A-bo and varieties with close consanguineous relationship in the late 1960s, they led the epidemics of wheat stripe rust caused by race 18 and race 19 of Puccinia striiformisf. sp. Tritici. In the 1970s, as wheat variety Taishan 1 was extended in north and northwest parts of China, they made race 24 and race 25 become predominant races, and caused significant losses of wheat production in these areas. By widely planting the varieties with Luofulin pedigree in the 1980s, they not only caused the rising of race 28 and race 29 rapidly and the loss of resistace to rust disease, but also caused the loss of resistace to powdery mildew disease. In the middle of 1990s, as Mianyang series varieties with stripe rust disease resistance like Fan 62 were popularized in production, they caused the epidemic of race 30 and race 31.

Some studies show that the extension of modern improved varieties is the main cause for the decrease of variety diversity. The narrow genetic base of modern improved varieties is the fundamental cause for genetic vulnerability. For instance, the hybrid rice has been planted widely in production, but most of its sterile lines are wild abortion (WA) type CMS lines, and its restorer lines are dominated by IR lines. The hybrid maize which accounts for about 60% of coultivated area in the country has the pedigrees of six major inbred lines (i.e. Mo17, Huangzao 4, E28, Zi330, Ye 478 and Dan340). According to the statistics that there are only 18 inbred lines with the planting areas over 100000 ha for each..Over 50％ of wheat varieties are with the pedigrees of Nanda 2419、A-bo, A-fu and Ourou. In 221 improved soybean varieties grown in the areas of Yellow River, Huaihe River and Haihe River, 137 are derived from Qihuang 1 and other four pedigrees (accounting for 61.9%). In 1376 varieties of land cotton, 1113 are contained pedigrees of 11 varieties which are from the USA and former Soviet Union.

In addition, since the pace of city and town-rization accelerating, intensity of agricultural production, over grazing, the construction of road and large-scale water projects，all these are an important factors for the decrease of diversity in crop varieties.

1.7 Requirements Assessment and Priorities for Development

1.7.1 Strengthening the Research on Origins and Evolvement of Cultivated Plants in Agriculture

We should make deep research on origins and evolvement of cultivated plants, especially to conduct systematic research on plants which the origin is not yet clear. At the same time, we should build the classification system for the varieties of different kinds of cultivated plants, scientifically classified the types of variation for diverse cultivated plants.

1.7.2 Strengthening Evaluation and Monitoring of Diversity and Genetic Erosion

We should give priorities to conduct evaluation on the state of diversity for major crops and their wild relatives, especially to conduct the evaluation on the state of diversity for varieties used in production. By intensifying the monitor of genetic erosion, we have formulated the technical lines and took some measures to prevent from or reduce the genetic erosion.

1.7.3 Strengthening the Condition Construction for Diversity Evaluation

The government should arrange the special financial resources to establish laboratories for genetic diversity evaluation, and develop standards and technical systems for genetic diversity evaluation.

1.7.4 Improve the Utilization Efficiency of Plant Genetic Resources

We should make great efforts to discover the local varieties and their wild relatives with good characters and excellent genes，expand the genetic base of breeding materials and efficiently remove the negative impacts caused by genetic erosion.

Chapter 2 *In situ* Management

Since the second half of the twentieth century the increase of population and rapid development of economics in China, have led to increase demands for survival in order to meet the new demands measures have been taken to expand cultivated areas, improve planting conditions, adjust industrial structure and increase the yield of crops. This has become a key way for the development of agriculture. But it also results in sharp decrease of species and quantity of cultivated crops. Crop varieties tend to be singleness. Habitats of wild plants have been damaged seriously. Plant genetic resources in nature conditions decreased rapidly. In order to check the permanent loss of plant genetic resources, the Chinese Government has made saving collections for plant genetic resources and conducted the work on *ex situ* conservation of plant genetic resources. Such work has gained significant results. Although the work on *in situ* conservation of plant genetic resources has been conducted later relatively, great progress has been made in last ten years. *In situ* conservation of plant genetic resources has entered rapid development stage.

2.1 Investigation and Catalogue

2.1.1 Survey of Wild Relatives of Plants for Agriculture

During period of 2002 to 2007, with the financial support from the Ministry of Agriculture, the Institute of Crop Sciences of the Chinese Academy of Agricultural Sciences organized the experts from agricultural research organizations, agricultural colleges and agricultural environmental protection system to make survey on wild crop relatives of 191 plant species which have been put into the List of Wild Plants Under State Protection. Based on widely collection of material with records on various species, we have studied the distribution of these species in different places in order to know the endangered situation of these wild relatives of crops. We have basically found out their distribution (at county level), ecological environment, vegetation conditions, associated plants, morphologic characters, protection value, endanger state of these species. Through collation and analysis, we have written a summary of wild plants under state protection

2.1.2 Survey on Important Wild Relatives of Plants for Agriculture

The main objective of the survey for wild relatives of key crops is to investigate the distribution of groups for each species, and to get to know the genetic diversity for each species. By making field investigation for six years, we have basically gotten know the state of resources of three wild rice species, three wild soybean species, 87 wild relatives of wheat, 8 species of aquatic plants, 8 species of *Rutaceae* plants and the resources of aweto, Mongolia Mushroom （*Tricholoma mongolicum* Imai） and *Nostoc flagelliforme.*

The survey on wild rice has been conducted at 53 counties in Hainan, Guangxi, Guangdong, Yunnan, Hunan, Fujian and Jiangxi provinces and autonomous region. The results of survey show that compared with the 1980s, the distribution sites of *O.rufipogon, O. officinalis* and *O.meyeriana* have been lost greatly or the areas have been decreased sharply. Meanwhile, eight new distribution sites for *O.meyeriana* and 35 new distribution sites for *O.rufipogon* have been found in Yunnan and Hainan Provincres and Guangxi Zhuang Autonomous Region. On the one hand a large number of wild rice resources have been damaged seriously, on the other hand with the improvement of transportation conditions, some wild rive resources grown in extreame remote areas have been found.

The survey on wild soybean has been conducted in 186 counties (cities) of 15 provinces. We invested previous 1200 distribution sites and found 200 new distribution sites and two perennial wild soybean distribution sites.The results show that the wild soybean is distributed widely in China. It not only has annual wild species but also has perennial wild species, and annual wild species can regularly grow in cold area with high latitude and high altitude.

The survey on wild wheat relatives has been conducted mainly in 133 counties (cities) of nine provinces and autonomous regions in northwest and southwest parts of China. 690 groups of 87 species of 8 genuses of wild wheat relatives have been investigated.

We have found diplod A.cristatum, Et.repens, leymus hochst and *Gramineae*

Kengyilia grandiglumis which are important species in sand-preventing, sand-fixing and protection of desert ecosystem.

In addition, we have made investigation on some endangered plant resources, such as aquatic plants in main water bodies, rutaceae plants and bast fiber plants in the Central China, tea in Yangtze River Valley, fruit trees in the North China and lower and middle reaches of Yangtze River, aweto in northwest and southwest parts of China, Nostoc flagelliforme in the North Chian and Tricholoma mongolicum Imai in Inn Mongolia. The results show that some aquatic plants like Najas pseudogracillima may be extinction in mainland China. The populations of other aquatic plants are very few in numbers and are in endangered or extinct state. Although there is no obvious changes in distribution scale for Rutaceae plants, its population are narrowed obviously, some populations are very few in number, the trend of reduce in numbers has not been checked efficiently. Since aweto has great market demand and its expensive price, it caurses over collection, together with the ecological deterioration, the yield reduced annually. Compared with the 1970s, the yield of aweto in major growing areas decreased by 50%, some areas reached 70％ and more. Since the climate getting warm gradually, rainfall reducing, overgrazing, degeneration of natural grassland and over collection， the ecological environments were damaged seriously, the natural yield of Tricholoma mongolicum Imai is decreased gradually. Nostoc flagelliforme grows in arid and semiarid areas of grassland where the annual rainfall is between 80～250mm. As over collection, the ecological deterioration and rainfall decreased annually. Nostoc flagelliforme is facing extinction.

2.2 Protection of Plant Genetic Resources for Food and Agriculture in Reserves (Protected Sites)

2.2.1 Nature Reserve

By the end of 2006, 2395 nature reserves with different types and at different levels were established in the whole country. The total area of the reserves is 151.53 million ha. The area of land nature reserves accounts for 15.16% of the national land area. Compared with 1993, the number of nature reserves has been increased near two times, the area is also doubled. In China, nature reserves are divided into three types:

natural eco-system reserves, wildlife reserves, nature relics reserves，of which, natural eco-system reserves occupy leading place either in quantity or in areas, accounting for 66.51% of total numbers and 68.41% of total areas of nature reserves respectively. Although a certain number of plant genetic resources have been conserved in established nature reserves, the nature reserves targeting plants as protection objects are quite fewer, their numbers and areas only account for 6.6% and1.92% of the totals respectively. In conserved plants, only few plants are associated with plants for food and agriculture.

2.2.2 *In Situ* Protected Sites for Wild Relatives of Crops

Since most of wild relatives are distributed in farming and pasturing areas, the ecological environments there have been damaged seriously. Habitat fragmentation has led the distribution scale of wild crop relatives of plant community becoming small, it is not suitable to manage them as conducted in protection areas. In order to avoid the plant genetic resources of wild crop relatives being lost in natural condition, from 2001, the Ministry of Agriculture has began to construct *in situ* protected sites for wild relatives of crops. Some protection methods which are suitable for use in China have been applied, such as fence, enclosing wall, natural barrier, plant fences, etc. We have also developed a series of technical specifications for construction of *in situ* conservation sites and for management, monitoring and early warning. Thus, we have made the work of *in situ* conservation of wild relatives of crops enter into scientifiction, standardization, institutionalization track. By the end of 2007, 86 *in situ* conservation sites for wild relatives of crops were established in 26 provinces, municipalities and autonomous regions. Other 30 *in situ* conservation sites have been listed in plan. All these *in situ* conservation sites involve 26 wild relatives of plants, such as wild rice, wild soybean, wild wheat relatives, wild lotus, *Glehnia littoralis* Fr. Schmidt ex Miq., Shanhucai, wild bckwheat rhizome (*Rhizoma Fagopyri Cymosi*), aweto, wild apple, wild cherry apple, wild sugarcane, wild citrus, Ilex latifolia Thunb, wild Chinese gooseberry, Zhonghua cress, wild tea, wild lichi, wild medlar and wild orchid.

2.3 Protection of Agro-ecosystem outside Nature Reserves

As limited by economy, technical conditions and awareness levels, the protection of agro-ecosystem outside the nature reserves has not yet included into the main programme of protecting genetic resources for food and agriculture. In recent years, with the increase of protection awareness of whole people on genetic resources for food and agriculture, economic conditions become better, the Chinese government has conducted relevant work.

2.3.1 By combining with Agricultural Production to Protect Wild Crop Relatives

With the financial support from the Global Environment Facility (GEF), the Ministry of Agriculture launched a project on Conservation and Sustainable use of Wild Relatives of Crops, and selected 8 sites of wild rice, wild soybean and wild barley relatives in 8 provinces (autonomous regions) as demonstration sites. With the help of international organizations in financial resources, technology and experience, by eliminating the adverse factors and their initiating causes threathening the quantity of wild plants in 8 demostration sites which represent the different socio-economic conditions in China, we can make much better to conserve rare and valuable wild relatives of crops. The general objective is to select 8 distribution sites in 8 provinces which are major areas of wild plant relatives in China. By taking some measures such as establishing sustainable incentive mechanism, perfecting the laws and rules, increasing the protection awareness and protection knowledge of local governments and farmers, and combining the protection of wild plant relatives with agricultural production activities, we have made them become important components in the activities of agricultural production.

2.3.2 By Using Ecosystem to Protect Agro-biodiversity

With the support from EU and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), the Ministry of Agriculture launched a project on Protection of Agricultural Biodiversity at Mountain Area in Southern Part of China in 2005. The pilot work on protection of agro-biodiversity has been conducted in 28 villages of 14 counties in Hainan, Hunan, Anhui, Hubei and Chongqing provinces (municipality). The basic ideas are: to combine the protection of agro-biotechnology with agricultural production; with poverty alleviation and improvement of farmers life quality; with the education of women and children, with new rural construction; with the projects on farmland protection and land preparation, with rural clean projects, and with the transfer of rural labor force. Through propagation, education, training and providing technical guidance, the farmers will not yet rely on the agro-biodiversity which is reduced gradually. Thus, we can meet our objectives for conservation. At present, the project has completed its investigation and planing and will be implemented soon.

2.3.3 Using Integrated Disease and Pest Management Method to Protect Local Varieties of Crops

According to the requirements of protection and utilization of agro-biodiversity and management of crop diseases and pests, the National Development and Reform Commission has established a first China National Centre for Apply-Technology of Agriculture Biodiversity in Yunnan Agricultural University to solve key scientific problems on applied technology of agro-biodiversity. By optimizing the arrangements of varieties, technical parameters and criteria and rules of population planting patterns, the Center has established 10 demonstration sites with the area of 667 ha for each for applied techniques of agricultural biodiversity. Thus, we have not only obtainrd 70％ of disease-controlling effects, but also desterilized and protected more than 230 local varieties of crops.

2.4 Major Problems Existed in *In Situ* Conservation of Plant Genetic Resources for Food and Agriculture

（1）The construction of nature reserves has mainly focused on the protection of diversities of eco-system and species levels, and has ignored the protection of genetic diversity levels. The losses of genetic diversity for the species protected in the reserves have not been included in the laws and regulations for the management of reserves.

（2）The *in situ* conservation sites of wild crop relatives have to some extent delayed the loss of genetic resources of wild relatives.At present, the method applied in *in situ* conservation sites is dominated by physical isolation. After completing the construction of conservation sites, the negetive factors are still exsisted in maintaining facilities, following-up management and changes in species composition. So the sustainability is poor.

（3）Although the eco-system has the sustainability in management, China is large in population, and difficult to harmonize and balance the contradiction between the economic development and protection of genetic diversity in a short time. We still have some difficulties in conducting *in situ* conservation of plant genetic resources in the whole country.

2.5 Requirements Evaluation and Priorities for Development

2.5.1 Formulating and Perfecting Rules and Regulations and National Plans

We should establish and perfect the system of national policies and laws & regulations which corresponds to Convention on Biological Diversity; revise China Biological Diversity Protection Action Plan and integrate genetic diversity protection into the plan for national economic and social development at national and local levels.

2.5.2 Developing Relevant Standards and Establishing Early Warning System

We should develop national standards on survey, data collection and management for biological resources, especially for wild plant genetic resources. Monitoring and early warning system for *in situ* conservation of wild relatives of plants should be established. The management and dynamic monitoring for the established *in situ* conservation sites should be enhanced.

2.5.3 Increasing Funds Input，Ensuring Sustainable Development of *In Situ* Conservation

We should increase investment of national special fund and strengthen international cooperation to continue survey and catalogue on wild plant genetic resources. Establishing new *in situ* conservation sites will be conducted and farmer participatory system for protection of wild plant genetic resources will be established. We have realized the combination of resources conservation with development and utilization and with the farmers benefit.

Chapter 3 *Ex Situ* Management

The activities of collection, conservation, identification, distribution and utilization of plant genetic resources for food and agriculture have been completed through the National Collaborative Network of Plant Genetic Resource for Food and Agriculture. The Network is constituted by leading unit, core units and collaborative units. The leading unit is the Institute of Crop Science of CAAS. Trusted by the Ministry of Agriculture, the mandate of the Institute is responsible for planning and implementating national projects on collection, identification, evaluation, catalogue, introduction, exchange, conservation, dissemination and infrastructure construction of plant genetic resources in the whole country. The core units are composed by more than 40 institutes of CAAS, including the Institute of Crop Science, Cotton Research Institute, Oil-bearing Crops Research Institute, Institute of Vegetables and Flowers, Institute of Grassland, etc.，their mandates are responsible for collection, identification, evaluation, cataloguing, introduction, medium-term conservation, propagation and regeneration and seed distribution for certain species of crop germplansm resources. Collaborative units include Academies of Agricultural Sciences at provincial and regional levels and agricultural universities concerned. They mainly participate in certain specific activities on plant genetic resources, for instance, to conduct collection, identification or evaluation work.

3.1 Status of Collections

Before plant genetic resources for food and agriculture become national germplasm resources collections, processing in experienmental trial, observation, quarantine, identification of basic agronomic characteristics, removal of duplicates and incorporation into “Catalogue of National Crop Germplasm Resources Collections”. After above processing the genetic resources materials will be regenerated and keep in national gene banks (nurseries) for long-term conservation. After that, deep identification and evaluation as well as distribution and utilization will be conducted. By December 2007, the total collections are 391,919 accessions, increased by 32,956 than 1996; among them 351,332 accessions are seed collections, 40587 accessions are plants and in vitro seedlings. According to preliminary statistics that in seed collections, 82% are domestic collections, and 18% are collections from abroad.. Among the domestic collections, local varieties account for 56%, and rare and valuable wild relatives of plants account for 10%.

3.2 Collecting

Since 1996, additional 32,956 accessions are mainly from following sources: First, they were collected through national collaboration network on plant genetic resources food and agriculture. The collecting objects are some local varieties have never been collected before. Some varieties were bred during the past ten years, and some are special materials which have significant studying value. Second, they are collected through field survey arranged by national projects. National projects on exploration of plant genetic resources for food and agriculture at San-Xia reservoir area at southern part of Jiangxi and northern part of Guangdong were conducted during 1996-2000. The project on investigation, evaluation and utilization of special germlasm resources for sand prevention and control implemented during the year of 2001-2002, and agricultural biology resources survey at Yunnan province and around areas was conducted in 2006-2010. Third, the plant genetic resources are introduced from abroad.

The specific exploring and collecting activities in recent years we conducted show the following characters: (1) emphasizing on the survey and collection of special/unique plant genetic resources and wild germplasm resources, as well as investigating the distribution, properties, survival environments and endangered levels of the special materials, and the roles they played in local agriculture, ecology and human survival and development, etc. All those information could be provided as the basis on how to better protect and sustainably use the materials. (2) The exploring and collecting activities are not only limited to the materials gathering, more attention is attached to the relations between the resources and local people's survival and developmen, so that it could provided information for further identification and evaluation. (3) The collecting activities are inclined to be more scientific, so as to guarantee the integrality of the collections. (4) The technical rules and procedures for collection of crop germlasm resources" was instituted (edited in 2007). It further regulates the procedures and technical steps for germplasm exploring and gathering, and introduction from abroad.

3.3 Types of Collections

We have preliminarily built up a national conservation system for plant genetic resources for food and agriculture, including one national long-term gene bank, one national duplication gene bank, 10 national medium-term gene banks, 32 national germplasm nurseries (including 2 in vitro seedling banks). Since 1996, new collections increased by 32,501 accessions. The total number of basic collections has reached 351,332 accessions (see table 3-1). All collections have been duplicated and preserved. Around 286,604 accessions have been multiplied and regenerated. They have enriched active collections in national medium-term gene banks (see table 3-2). 38,803 accessions are field collections (see table 3-3) and 1784 are in vitro collections (see table 3-4).

Table 3.1 Basic collections in national long-term gene bank

Crops	Accessions in gene bank	No. of Species		Species	Accessions in gene bank	No. of Species
rice	64210	21		cotton	7226	19
wild rice	5588			bast fiber crops	5071	7
wheat	41030	134		rape	6300	13
wheat relatives	2009			peanut	6565	16
barley	18557	1		sesame	4726	1
maize	19088	1		sunflower	2646	2
millet	26636	9		special oil bearing crops	7749	4
soybean	24931	4		Watermelon, melon	2022	2
wild soybean	6644			vegetables	30482	135
edible beans	25938	17		grasses	3712	387
tobacco	3407	22		Oat	3287	3
sugar beet	1373	1		buckwheat	2582	3
Proso Millet	8451	1		green manure	663	71
sorghum	18263	1		others	2176	2
Total					351332	735

Table 3.3 Active collections in medium-term gene banks

No.	Name of medium-term gene banks	Crops	Accessions
1	National center for crop germplasm preservation	Cereal, soybean, edible bean, minor crops	175,600
2	National medium-term gene bank for rice	Rice	50,768
3	National medium-term gene bank for cotton	Cotton	5,350
4	National medium-term gene bank for flax crop	bast fiber crops	4,426
5	National medium-term gene bank for oil crops	Oil crops	20,769
6	National medium-term gene bank for vegetables	Vegetables	22,265
7	National medium-term gene bank for sugar beet	Sugar beet	906
8	National medium-term gene bank for tobacco	Tobacco	2,500
9	National medium-term gene bank for pasture	Grasses	2,200
10	National medium-term gene bank for Watermelon and melon	Watermelon, melon	1820
	Total		286604

Table 3.3 National germplasm nurseries for field collections

No.	Name of germplasm nurseries	Crops	Accessions	No. of Species
1	Beijing peach and strawberry nurseries	Peach	195	4
		strawberry	107	10
2	Taigu date and grape nurseries in Shanxi Province	Chinese date	262	2
		Grape	374	8
3	Xiongyao plum and apricot nurseries in Liaoning Province	Plum	601	8
		Apricot	499	8
4	Gongzhuling hardy fruit nursery in Jilin Province	Apple, pear, hawthorn	358	44
5	Nanjing peach and strawberry nurseries in Jiangsu Province	Peach	353	6
		strawberry	153	12
6	Fuzhou longan and loquat nurseries in Fujian Province	Longan	154	2
		Loquat	220	3
7	Tai'an walnut and chestnut nurseries in Shandong Province	Walnut	129	9
		Chestnut	142	5
8	Wuchang sandy pear nursery in Hubei Province	Pear	343	7
9	Wuhan aquatic vegetable in Hubei Province	Aquatic vegetables	2,924	49
10	Guangzhou wild rice nursery in Guangdong Province	Wild paddy	3757	20
11	Guangzhou lichee and banana nursery in Guangdong Province	Lichee	89	1
		Banana	234	6
12	Guangzhou sweet potato nursery in Guangdong Province	Sweet potato	1,045	3

13	Nanning wild rice nursery in Guangxi	Wild rice	3,496	1
14	Unique fruit trees and rootstock nursery in Yunnan Province	Unique fruit trees and rootstock	541	120
15	Kaiyuan Sugarcane nursery in Yunnan Province	Sugarcane	1,921	15
16	Luntai Unique fruit trees and rootstock nursery in Xinjiang	Unique fruit trees	450	31
17	Shenyang hawkthorn nursery in Liaoning Province	Hawthorn	175	10
18	Mei County Persimmon nursery in Shanxin Province	Persimmon	356	7
19	Xingcheng apple and pear nursery in Liaoning Province	Apple	579	24
		Pear	585	15
20	Chongqing citrus nursery	Citrus	683	16
21	Zhengzhou peach and grape nurseries in Henan Province	Grape	604	25
		Peach	286	12
22	Zhenjiang mulberry nursery in Jiangsu Province	Mulberry	1,910	1
23	Hangzhou Tea nursery in Zhejiang Province	Tea	1,514	1
24	Changsha Ramie nursery in Hunan Province	Ramie	4,485	28
25	Beijing Wild wheat relatives nursery	Wheat	1,695	219
26	Wuchang Wild peanut nursery in Hubei Province	Peanut	40	33
27	Hainan Wild cotton germplasm nursery	Cotton	552	36
28	Zuojia Grape nursery in	Grape	250	1

	Jilin Province			
29	Zhanzhou Rubber germplasm nursery in Hainan Province	Rubber tree	6,310	7
30	Perennial pasture nursery in Inner Mongolia Autonomous Region	Pasture	432	147
	Total		38,803	956

Table 3.4 National In vitro seedling banks

No.	name of nursery	crops	accessions	No. of species
1	Keshan Potato in vitro seedling bank in Heilongjiang Province	potato	887	8
2	Xuzhou Sweet potato In vitro seedling in Jiangsu Province	sweet potato	897	8
	Total		1,784	16

3.4 Preservation Facilities

During the period of 1996-2007, the Ministry of Agriculture invested 120 million Chinese Yuan in "Seed Project" for enlarging preservation facilities and improving existing facilities. It includes: (1) enlarging 2 national gene banks, one is "National crop germplasm preservation center"located in Beijing and another is "National germplasm duplication gene bank" located in Qinghai Province; (2) improving facilities for8 medium-term gene banks which cover rice, cotton, fiber crops, vegetables, tobacco, pasture, sugar beet, oil crops. Meanwhile, renewing refrigerating system and pretreatment facilities of national gene banks; (3) building additional 7 national germplasm nurseries, which include vegetative reproduction and perennial vegetables germplasm nursery in Beijing, wild apple germplasm nursery in Yili (Xinjiang Autonomous region), waxberry germplasm nursery in Nanjing (Jiangsu Province), tropical fruit germplasm nursery in Zhanjiang (Guangdong Province), cassava and tropical pasture germplasm nursery in Zhanzhou (Hainan Province), tropical palm germplasm nursery in Wenchang (Hainan Province), tropical spicery and beverage germplasm nursery in Xinglong (Hainan Province); (4) transforming basic preservation facilities for 30 national germplasm nurseries. The transformation and expanding of preservation facilities has extremely enhanced the capacity of safe preservation for Chinese plant germplasm resources. By December 2007, the status of preservation facilitiesis shows in Table 3-5.

Table 3-5 Status of preservation facilities

No.	types of preservation facilities	numbers		preservation condition	
		original	New added or on-going building	original	improved condition
1	National long-term gene bank	1		－18℃，RH≤57％	－18℃，RH≤50％；All refrigerating facilities are replaced
2	National duplication gene bank	1		－10℃；Preservation capability is 400,000 accessions	－18℃，RH≤50％；Preservation capability increased to 600,000 accessions
3	National medium-term gene bank	10		0～10℃	－4～＋4℃
4	Provincial medium-term gene bank	12	17	0～10℃	0～10℃
6	National germplasm nursery	30	7		refurbishment and extension of infrastructure
7	National in vitro seedling bank	2			refurbishment and extension of infrastructure

3.6 Security of Conserved Germplasms

The main factors influencing the security of germplasms conserved in gene banks include storage conditions, decrease of seed viability and variation of genetic integrity. The main factors influencing the security of germplasms conserved in germplasm nurseries are natural disasters (including diseases and pests), remove of germplasm nurseries and germplasm aging.

3.5.1 Security of Germplasms Conserved in Gene Bank

Storage Conditions, Keeping gene bank at low and constant temperature is the first condition for security of conserved germplasms. In order to keep electric power to be supplied continuously, double lines of electric power have been applied in national long-term gene bank in China. In addition, strengthening the ordinary safety management for germplasm and preventing fires and other accidents occurring are prerequisites for ensuring the safety of germplasm. The refrigeration and power supply facilities running about 29 years in National Gene Banks were renewed and transformed respectively in 2001 and 2007 in order to ensure normal operation of refrigeration facilities and power supply system for a long time. In addition, we have established a germplasm conservation system that long-term gene banks, duplication gene banks and medium-term gene banks will keep copies each other, thus, it will avoid the loss of plant genetic resources resulted by special causes.

Decrease of Seed Viability Germplasm aging has resulted in decrease of seed viability. It is one of most important biological factors for the security of germplasm. From 1997, the national gene bank has begun to detect the viability for some crop seeds stored for 10-20 years in long term gene bank. The detected materials accumulated to 36000 accessions of 46 crops. The results show that （1）In general, decrease of viability is not obvoius（≥85%），but the germination rate of 1.1% detected seeds decreased obviously (below 70%)，The main reason may be that the differences were caused by storage ability of different species or same species with different varieties;（2） Different crops existed apparent difference in viability. The viability of carrot, lettuce, cotton and watermelon reduced significantly，some seeds with short life also show poor storage ability at low temperature, such as carrot, lettuce,etc.；（3）Different reproductive sites have also effects on decrease of seed viability;（4）For the varieties with high seed viability when they were put into the bank, their high seed viability can keep a longer time.

Changes of Genetic Integrity To reduce the change of genetic integrity in the storage and regeneration of germplasm and maximum maintain the genetic integrity of germplasm is an important condition for ensuring the security of germplasm. The researches conducted both at home and abroad show that genetic variation caused by germplasm aging（e.g. chromosomal aberration） appear to be no adverse effect on conservation of germplasm. But in the regeneration of germplasm, the germination rate of seeds, size of reproductive population and seed sampling pattern at harvest are the key factors for maintaining the genetic integrity of germplasm, especially for heterogeneous materials in genetics. The researchers working in national gene banks use electrophoresis technology of gliadin proteins to detect the changes of genetic integrity of wheat and apply SSR markers to detect the changes of genetic integrity of soybean. Each of them has 30 accessions as experiemental materials. The results show that the germination rate at regeneration stage is an essential factor for maintaining the genetic integraty of heterogeneous germplasm. In addition, some scholars have also conducted the research on optimum propagation techniques for maize, Chinese cabbage, buckwheat, multiflora bean (*Phaseolus multiflorus* Willd), Job's-tears and sesame. The results show that when the number of reproductive population of maize is 200 plants, the genetic integraty of basic seeds is better than that of population with 100 plants and 50 plants. For the seeds taking from different ears with same numbers as materials conserving in gene banks, their population diversity is higher than that of seeds taking from same ears with same numbers. Therefore, to take scientific seed propagation and sampling techniques are important measures to keep the genetic integrity of cross-pollination crop germplasm. At present, China has formulated "the Regulations of Regeneration Techniques for Crop Germplasm Resources". It has standardized the technical procedures and index for regeneration and ensures that the genetic integrity will not be lost in germplasm regeneration.

3.5.2 Security of Germplasms Conserved in Germplasm Nurseries

The main factors influencing the security of germplasms conserved in germplasm nurseries are natural disasters (including diseases and pests), remove of germplasm nurseries and germplasm aging. Natural disasters such as flood damage, snow freeze disaster, diseases and pests are the main factors for the safety of germplasm conserved in germplasm nurseries. In July, 1996, Yuanjiang in Hunan Province suffered from special flood, ramie nursery was flooded about 49 days, 900 accessions of ramie germplasm resources were lost. In January 2008, the South areas were afflicted by snow and freeze disaster，Changsha Ramie Nursery and Wuhan Aquatic Vegetable Nursery have suffered from snow and freeze disaster with different degrees. The removemet of germplasm nurseries caused by expansion of cities, construction of large water conservancy projects and roads resulted in the damage of ecological conditions for germplasm nurseries. Therefore, some national germplasm nueseries had to remove. For instance, the national nurseries for ramie germplasm resources were removed from Yuanjiang to Changsha, Hunan Province in June 2004. The national nurseries for Taian walnut and chestnut germplasm resources were established in 1985, and in 2003, the whole nurseries were removed. So it’s hard to avoid the loss of some resources in removement. The aging of germplasm in germplasm nurseries is also an important factor in influencing the security of germplasm conservation.

3.6 Information Compilation

We have developed 336 standards or criterions on description of crop germplasm resources, data standards and quality control of the data. The standard systems with scientific classification, unified catalogue and unified description for crop germplasm resources have been formed. We have publicated 110 volumes of a series books on Technical Standards for Crop Germplasm Resources.

We have a national database system for crop germplasm resources which contains the information on 180 crops and 390000 accessions of germplasm. The system covers 11 sub-systems, including the management of national gene bank, management of Qinghai duplication gene bank, management of national germplasm nurseries, management of national medium-term gene bank, evaluation and identification of crop characters, comprehensive evaluation of elite resources, exchange of germplasm resources both at home and abroad, survey of crop germplasm resources and germplasm images, with about 700 databases and 1.35 million records. The data volumes have reached 100GB.

In 1996, we established a Crop Germplasm Resources Information Network in China（http://www.cgris.net/）. In 2007, we established a Website on common share of national germplasm resources of plant. We have provided information shareing service on crop germplasm resources to one million more people/times.

We have successfully developed a series of application softwares, such as e-map system on crop germplasm resources in China, information system for trait distribution of major crop germplasm resources in China, WebGIS for major crop germplasm resources, the automatic fingerprint image identification system for crop germplasm resources（GEL）, expert system for regeneration of the seeds conserved in gene banks（RES）, and GIS/GPS for wild species of crop plants.

3.7 Seed Distribution

For Long-term Gene Bank Since 1998, More than 120 research organizaions like Yunnan Academy of Agricultrral Sciences, Shanxi Academy of Agricultrral Sciences, Yandu Agricultural Research Institute in Jiangsu Province, Hunan Rice Research Institute, Hunan Institute for Application of Atomic Energy in Agriculture, the Institute of Tabacco, CAAS have withdrawn 65000 accessions of germplasm resources from long-term national gene banks as basic materials for regeneration. These materials become extinet in these oiginal organizations. These activities on regeneration have supplemented germplasm resources in medium-term gene banks and increased the ability of distribution and supply seeds from medium-term gene banks.

Medium-term Gene Banks And Germplasm Nurseries Since 2001，through the implementation of special project of conservation and utilization of crop germplasm resources launched by the Ministry of Agriculture, we have regenerated

286,604 accessions of germplasm resources and have efficiently solves the problems of no seed supply in medium-term gene banks. In the past 7 years, we have provided 2650 units all over the China with 132000 accessions of germplasm resources which cover 220 species or types, of which, ten medium gene banks have supplied 91000 accessions to 1730 units. 32 national germplasm nurseries have distributed 41000 accessions of germplasm resources to 920 units. The main purposes of asking for resources are using them as parents for breeding, selecting for direct use, for scientific research, and used as specimen for museum and for exchanges with foreign countries. The main persons asking for resources are breeders, researchers, teachers, students, farmers, and popular science workers. In addition, the gene banks or germplasm nurseries have been used as bases by universities, middle schools and primary schools for teaching, visit and practice.

3.8 The Functions of Botanical Garden

There are about 170 botanical gardens in China. They could be divided into 5 types:（1）Scientific botanic gardens represented by the Botanic Garden of the Chinese Academy of Sciences. The functions include the conservation of species, scientific research, resources development and public education;（2）Botanic Gardens established by city construction sectors, garden sectors or tourist sectors with the purpose of demonstrating plants and entertainment, such as Beijing Botanic Garden, Hangzhow Botanic Garden;（3）Botanic Gardens established by education sectors with the purpose of using plants to teach and do exercise, such as Beijing Teaching Botanical Garden, the Tree Garden of Nanjing Forestry University;（4）Botanic Gardens established by medicine sectors with the purpose of collection and show of medical plants, such as Beijing Medical Botanic Garden, Nanning Medical Botanic Garden;（5) Botanic gardens established by agricultural and forestry sectors with the purpose of collection of forest tree germplasm resources, such as Nanyue Tree Garden，Changsha Botanic Garden. Some botanic gardens have become important research centers introducing and demonstrating plants, developing and utilizing resources, translocation conservation, and garden & landscape construction., treasury of resources and the base for popular science education. At present, there is no specific botanic garden for the conservation of plant genetic resources for food and agriculture.

3.9 Requirements Evaluation and Development Priorities

3.9.1 Strengthening Exploration and Collection of Plant Genetic Resources

Although China has launched several campaigns on exploration and collection of plant genetic resources，there is a gap for minor crops, wild relatives of plants and germplasm from remote mountainous areas where transportation is difficult. With the rapid development of economics, the steps of agricultural production intensity and development of mountainous area speeding up, the loss of plant genetic resources is also speeding up. Therefore, we should strengthen the survey, exploration and collection of plant genetic resources, and avoid loss of special and unique plant genetic resources in China.

3.9.2 Establishing and Perfecting Preservation System for Plant Genetic resources

According to calculation that in the future, about 150000 accessions of plant genetic resources will wait for entering gene banks for storage in China. At present, the capacity of national gene banks is not enough for storing such amount of materials. Therefore, we should establish new national long-term gene banks and expand the capacity of storage. Meanwhile, we should increase in vitro seedling conservation banks, cryopreservation banks and DNA banks. In addition, we should continue to establish new germplasm nurseries.

3.9.3 Intensifying the Studies on Techniques for Safe Conservation of Germplasm Resources

The mechanism of seed aging and genetic variation is not clear at present. The life difference is existed between species and varieties. Moreover, we do not know the injury levels of germplasm before they enter the bank and the genetic drift and shift in regeneration. Therefore, it is hard for us to detect and control the decrease of viability for germplasm stored in gene banks. It is urgent to conduct the research on the theory and techniques of safe conservation of germplasm at low temperature banks, including monitoring techniques of viability, testing techniques of genetic integrity, rescuing technique for endangered germplasm resources, standards for germination rate and optimum techniques for regeneration. In addition, we should strengthen the research on the technique of tissue culture conservation and cryopreservation through international cooperation.

Chapter 4 Utilization

Plant genetic resources for food and agriculture are an important component of biodiversity with basic, public interests, long duration and strategic characters. Sufficient use of plant genetic resources for food and agriculture is a substantial basis and important guarantee for realizing original innovation of plant science, food security, ecological security, sustainable development of agriculture and increase of farmers' income.

4.1 Factors Affecting Use and Limiting Use of Plant Genetic Resources

4.1.1 Status of Utilization of Plant Genetic Resources

The utilization of plant genetic resources may be divided into four aspects: 1. For basic research. The aim is to reveal relationships between mechanism of molecular biology in plant grown and their systemic evolution, and provide theoretical basis for original innovation of plant science; 2. Making use in identification of elite characters and pre-breeding; exploring new genes and creating new parent materials which are in conformity with breeding targets; 3. Using as parent materials to develop new varieties, and providing guarantee for food security; 4, For teaching and exhibition, and raising whole nation's consciousness on protection of plant genetic resources..

By distribution of questionnaires, making field investigation, holding workshops and searching relevant documents and information, the former Institute of Crop Germplasm Resources of CAAS has made investigations on the utilization of 13682 accessions of germplasm resources released from national gene banks (nurseries) in the period of 1984-1998 and found that about 9% of resources have been used for basic research, 8% for breeding, 21% for identification of good characters and pre-breeding work, the other 62% have been used for education, exhibition or haven't been used. In the types of resources which have been used, improved varieties account for 38.8%，advanced materials for 32.5%，local varieties for 22.4%，wild materials for 4.1%，and genetic materials for 2.2%.

It is particularly to point out that plant genetic resources have played an important role in developing new varieties. Since 1950, the staple crop varieties have been changed 4 to 6 times in China. The coverage rate of improved varieties is over

85%. The yield increased about 10% by changing the varieties for each time. The resistance and quality of crops have been increased significantly. The contribution rate of elite germplasm resources is over 50% in plant breeding and seed industry.

4.1.2 Factors Limiting the Use of Plant Genetic Resources

In the past decade, China has made remarkable achievements in the use of plant genetic resources. But from the development point of view, we still have some constraints in utilization. They are mainly as follows: 1.The research on these genetic resources at gene levels are leg behind of breeding requirements. Although we have conducted partial work on the identification of genotypes, the types of crops and the quantity of germplasm resources, the different crops and accessions, we covered are extremely limited, and lack of systematic and deep research on gene diversity levels, quantity of new genes, functions, the value of utilization of 392000 accessions of genetic resources conserved in gene banks, so it is difficult to provide breeders and researchers on basic theory studies for targeting resources. 2. We have not established mechanism of benefit-sharing clearly. At present, we have no concrete policies and regulations on how to show the rights and obligations of scientists on germplasm resources from performance assessment and intellectural property rights. So it is difficult for resources providers to obtain information on the use of resources; 3. Facing the new demands of breeding, it is urgent for us to formulate evaluation standards. With the warming of climate and changes of ecological environments, we should adjust the objectives of breeding. The key characters of genetic resources for evaluation should be also adjusted. Therefore, we should target the new characters to develop new standards for evaluation. Thus we can select new germplasm which are in conformity with breeder's requirements.

4.2 Identification， Evaluation and Utilization of Plant Genetic Resources

4.2.1 Identification and Evaluation

In order to obtain more scientific and more credible data of identification, China has prepared series books of Technical Standards for Crop Germplasm Resources to provide guidance for identifying phenotype of plant genetic resources. Meanwhile, we have conducted a series of work on phenotype identification, such as evaluation of genetic diversity, discovery of new genes and identification of functions. We have conducted the work on identification, evaluation and field demonstration for elite resources with targeting characters needed by breeders for many years in different sites.

Phenotype Identification and Evaluation. The identification and evaluation are mainly focused on botanical characters, yield traits、disease resistance, pests resistance、stress tolerance, nutrition components and quality of process, and efficiency use of nitrogen and phosphorus. Compared with phenotype identification and evaluation conducted before, after 2000, we have intensified the work on indentification and evaluation of different races in major diseases, evaluation of efficiency use of nitrogen and phosphorus, salinity and drought tolerance during the whole growth period, evaluation of micronutrient contents, such as Fe and zinc， and character identification. The empheses have been given on the integrity evaluation of same genetic resource with different phenotypes. Overall, the plant genetic resources conserved in China are rich in elite characters. For instance, in cultivated rice resources which have been identified, 835 accessions are immune to rice blast disease， accounting for 1.8% of identified germplasms, 2685 accessions with high resistance to rice bacterial leaf blight disease； accounting for 5.9%, 2319 accessions with high resistance to brown planthopper(*Nilaparvata lugens* Stal), accounting for 5.2%, 2841 accessions with high resistance to whiteback planthopper (*Sogatella furcifera* (Horvath)), accounting for 8.2%, 3512 accessions are cold tolerant germplasm in germination stage, accounting for17.1％, 3170 accessions with drought tolerance in seedling stage, accounting for14.9％, 580 accessions with salt tolerance, accounting for3.2%。

Evaluation of Genetic Diversity. In recent years, by comprehensive use of some analysis methods with morphologic, protein and DNA marker, we have conducted the research on changes of genetic diversity for varieties developed in different years, genetic composition of local varieties, and geographic subdivision of diversity. For example, we have made genetic diversity analysis for more than 310 rice varieties developed from 1950. The resuilts show that the difference of genetic diversity varys significantly in different years. The varieties developed in the 1950s are higher in genetic diversity. And after that, the varieties we developed show decrease in genetic diversity. For the varieties developed in recent decade, their genetic diversity has incresed to some degree. The genetic diversity of indica varieties has shown significant decrease than that of japonica ones. By conducting the analysis on genetic diversity for 133 local varieties of wheat, we found that the areas rich in genetic diversity are winter wheat growing areas in Yellow River and southwest part of China. The lowest areas of genetic diversity are winter wheat growing areas in the South and spring wheat growing areas in the Northeast. Although local wheat varieties have show a great uniform in main agronomic characteristics, over 75％ varieties are with mixed genotype in individuals, different genotypes exist relative stable proportion, and each individual is homozygous genotype. In different individual wheat plants, rich allele gene diversities are found with good quality and disease resistance. By conducting analysis of genetic diversity for 1863 local varieties of soybean, the results show that local varieties are dominated by geographical differentiation, supported by ecotypic differentiation. It means that the common effects of natural selection and artificial selection have formed aboundant genetic diversity of local soybean varieties.

Building Core Collection On the base of phenotype evaluation and genetic diversity analysis using modern molecular marker technology，we have built core collection for some crops like rice, wheat, maize, soybean, cotton, barley millet, etc. and mini core collection for rice, wheat, maize and soybean. Using mini core collection as material, we have made deep analysis on them which may carry some elite genes and have found molecular markers for these genes. They have laid foundation for molecular marker-assisted breeding. In addition, we should use mini core germplasms as donor parents to make cross and back cross with major varieties used in production, expand genetic base for breeding, develop new varieties with high-yielding, disease resistance, drought tolerance, salinity and alkalinity tolerance, broad adaptability and good quality.

Exploration of Function Genes. Targeting the main objectives in breeding and production, we have discovered a large number of important function genes by using modern theory and techniques of molecular biology, especially in exploring functional genes associated with yield, quality and drought tolerance and have obtained remarkable achievements. For instance, we have found two gene loci from *O.rufipogon* which can increase the yield of hybrid rice by 25.9% and 23.2%. Using molecular marker and map-based clone methods, we have isolated *MOC1* gene required for tillering control in rice. In wheat genetic resources, we have found the gene loci which can significantly increase the ears and grains.；We have found the gene loci in cotton resources which are associated with the development of fibres. With the discovery of these functional genes, we have laid the foundation for genetic engineering breeding.

Precision identification and field demonstration Since 2005, we have conducted precision identification and evaluation of elite resources with targerting characters needed by breeders in crop genetic resources of rice , wheat, maize, soybean, cotton, and rape in 3-5 ecological areas for a period of 3-5 years, demonstrated them in the field, invited breeders to make on spot visits，selected germplasms suitable for breeding objectives, and advanced the use efficiency of elite genetic resources.

4.2.2 Pre-Breeding and Germplasm Enhancement

In order to broaden genetic base of breeding, in recent years, by using of wide cross and other tools, expected genes from alien species have been transferred to cultivars. Remarkable progresses have been made in methods and material enhancement.

With the targets of developing varieties with high yielding, good quality, disease resistance and stress tolerance, we have created a set of breeding materials and genetic materials. For example, by transferring *yld1.1* and *yld2.1* gene loci of *O.rufipogon* with high-yielding into cultivars, we have created a main parent Q611（restore line） as a candidate for super rice. Both gene loci have been used by breeders.. By crossing bread wheat with *Agropyron cristatum* <L.> Gaertn.(2n=4x=28, PPPP）, we have created over 30 alien translocation lines with genes of *Agropyron cristatum* which possess the genes with many pollen and grains, drought tolerance, and resistance to powdery mildew and stripe rust. Breeders have developed two new bread wheat varieties with them. Using radiation-induced mutation breeding techniques, we have created new cotton materials with large boll and good quality of fibre and developed elite hybrid cotton Zhongmiansuo 48 with large bolls which has been used in production.

4.3 Utilization of Diversity of Plant Genetic Resources

With the deepening of genetic base analysis for modern cultivars and the change of races for major diseases，the breeders should pay more attention to use diversity of genetic resources to develop new varieties with disease and pests tesistance and stress tolerance, and to make varieties with diverse planting patterns.

4.3.1 High-yielding Breeding

To obtain high yielding is always an important objective for crop breeding in China. Exploration and utilization of germplasms or genes with high-yielding potentials in plant genetic resources is much important. For instance, in rice breeding, with the discovery of photoperiod-sensitive male-sterile rice gremplasm Nongken 58S, we can use the wide compatibility gene and photo-sensitive genic male sterile line gene in breeding, so we initiate a new strategy on the use of heterosis of inter-subspecies between indica and japonica rice for high-yielding breeding. We have developed in succession a number of elite two-line hybrid rice combinations, such as Liangyoupeijiu, Peiliangyou 288, Xiangliangyou 68, Peizashuangqi, etc., of which, Liangyoupeijiu was demonstrated in 34 sites with area of 500 ha in Hunan and Jiangsu provinces. The yield was over 10.5 ton/ha. It was popularized in the whole nation in 2001 with cultivated area of 1.133million ha. The yield reached 9.2ton /ha.

4.3.2 Quality Breeding

The crop breeding in China has been shifted from merely increasing yield to the increase of yield and quality. New bred varieties have been improved obviously in quality. For example, in 605 soybean varieties developed in 1993 to 2004, there are 103 varieties with protein contents over 45％, accounting for 17.0%, 71 with fat contents over22％, accounting for 11.7％. In quality peach breeding, using local varieties of flat peach Chenguopantao and Bmangpantao to improve commercial peach cultivars and nectarine，we have developed 20 Tiaorui series new varieties of flat peach，and have overcomed some shortcomings, such as the fruits of local varieties are soft, split on top and low yield, and maintained the fragrant and sweet characters of flat peach. During the period of 1996-2007, the planting areas were over 33000 ha，increased by two times.

4.3.3 Disease-resistant Breeding

In disease resistant breeding, great attention has been given to use genetic resources with broad resistant genes, new genes and multi resistant genes to diseases and pests. For instance, using a resource which has broad resistance to rice bacterial blight we have developed four new hybrid rice varieties, of which two have been examined and approved at national level and other two have been examined and approved at provincial level. Using new genes with resistance to stripe rust we have developed some new wheat varieties such as Chuanmai 42. These varieties do not only have the resistance to races 30, 31 and 32 of stripe rust which are epidemic currently in production, but also solve the problems of resistance to stripe rust in the Southwest wheat growing areas after 2000. They have become important parents for developing high-yielding varieties in the Southwest wheat growing areas. Using maize resources with resistance to maize bacterial wilt, maize dwarf mosaic disease, gray leaf spot and maize borer we have developed some new varieties which do not only obviously increase the comprehensive ability of resistance to diseases and pests, but also increase the 1000-grain weight which has increased by about 50g than that of check variety Zhengdan 14.

4.3.4 Drought-Resistant Breeding

In recent years, the main breeding objectives for some staple crops like rice, wheat and maize are focused on drought resistant breeding and water-saving breeding，and great achievements have been made in these fields. For instance, wheat resources Jinmai 63 and 82230-6 with excellent drought resistance were selected and provided them to breeders, six new varieties have been developed. Their suitability covers dry land in Huanghuai winter wheat growing areas, dry land in the North winter wheat growing areas and wet land in the North winter wheat growing areas. Of which, accumulated growing area for new variety Chang 6878 in the North winter wheat growing areas has reached about 1.3 million ha. Accounting for 65％ of local planting areas.

4.3.5 Diverse Cultivation of Plants

To plant crops with diverse patterns is the fine tradition for China agriculture. In recent years, such patterns have not only been strengthened, but also developed by planting same crop with different varieties to control diseases and pests. For instance, from 1998, Yunnan Agricultural University and IRRI have jointly conducted the research on diversity of rice varieties in Yunnan, Sichuan and Jiangxi provinces. They have used resistant varieties to make mixed cropping with susceptible ones to control the occurrence of rice blast. By using of high-yielding hybrid rice varieties Xianyou 63 and Xianyou 22 to intercrop with quality glutinous rice varieties Huangkenuo and Zinuo which are susceptible to rice blast, serious degree of rice blast in mixed cropping field reduced by 80％, yield increased by 6.5％～8.7％, and benefit increased by 10％ compared with quality glutinous rice varieties in single cropping.

4.4 Requirements Evaluation and Priorities for Development

4.4.1 Strengthening Identification and Systematic Evaluation of Plant Genetic Resources

Targeting the important characters or genes urgent demanded in production and breeding, we should perfect and establish technical standards and method for evaluation of plant genetic resources, make deep and wide work on identification and evaluatin, discover targeting genes with high-yielding, good quality, disease resistance and stress tolerance in local varieties and wild species, reveal their functions，provide them for use in breeding, expand genetic bases which are narrow in breeding., and raise the use efficiency of plant genetic resources.

4.4.2 Strenghthen Research on Elite Characters of Major Varieties Used in Production

By using of improved varieties cultivated commercially in production as materials, we have made comprehensive and systemically research on composition of good characteristics, explored the molecular biology basis and genetic rules for the formation of good characteristics, provided guidance on identification of plant genetic resources and enhancement of germplasm, and made the resource to meet the demands of breeders.

4.4.3 Conducting the Research on Healthcare Functions

Based on rich plant genetic resources in China, we should select and identify the germplasms rich in healthcare function, study the genetic characters and using way of factors of healthcare function, develop products with healthcare functions, boost new type industry, increase farmers' income and improve the human health.

Chapter 5 National Plan, Training and Legislation

By formulating and implementing a series of national plans, the Chinese Government has intensified the training, with the purpose of raising public awareness of conservation of plant genetic resources and the pulic, and by establishing legislation and perfecting relevant systems to strengthen the safe protection and sustainable use of plant genetic resources for food and agriculture.

5.1 National Plan for Plant Genetic Resources for Food and Agriculture

In 1994, the Chinese Government issued China Agenda for the 21st Century and the Action Plan of Biodiversity Conservation in China. The Ninth-Five-Year Plan of the People's Republic of China on National Economy and Social Development and Outlines of Objectives in Perspective of the Year 2010 and the Outline of the National Program for Long- and Medium-Term Scientific and technological Development (2006-2020) were issued in 1996 and 2006 respectively. All these national programs or plans have taken the conservation and utilization of plant genetic resources for food and agriculture as important areas or priority subjects, 12 national projects on conservation and utilization of plant genetic resources for food and agriculture have been established and implemented in national major scientific plans, such as 973 programme, 863 programme, national program with scientific support, establishment of infrastructure platform for science and technology, as well as Seed Engineering Project, Protection of Wild Agricultural Plant Resources. All these have made remarkable achievements.

In 2000, the Ministry of Agriculture initiated a project on conservation and utilization of crop germplasm resources，300000 accessions of crop germplasm resources have been multiplied and regenerated . Precision identification and evaluation of crop germplasm resources were conducted. In 2003, the Ministry of Science and Technology initiated a project on platform establishment of crop germplasm resources, formulated description standards, data criteria and control standards of data quality for 120 crop germplasm resources, published 110 series books on Technical Standards for Crop Germplasm Resources, completed the integration, standardization documentation, catalogue and digital expression for 152000 accessions of germplasm resources, In 1998, we began to implement the 973 programmes on Establishment of Core Collection of Crops and Study on Discovery and Efficient Use of New Important Genes. By using of modern biotechnology, especially the theory and method of plant genomgics to study and develop abundatant crop germplasm resources in China. We have solved the problems of narrow genetic base in breeding parents. It has laid gene resources base for sustainable development of agriculture in China. In 2002, we initiated a plan on exploration and collection of wild crop plants and their *in situ* conservation（2002-2010）. The aim is to make clear the distribution of 191 species listed in List of Wild Plants Under State Emphasized Protection （agriculture section）, and by selecting representative populations to establish in situ protection zones (sites) for agricultural wild plants. At present, we have basically gotten the distribution of most wild species of crop plants. We have established 86 *in situ* conservation sites for wild crop plants，of which, wild rice, wild soybean and wild wheat relatives are main components. We launched a project on conservation and sustainable use of wild relatives of crop plants（2005-2011） in 2005. The objective is to combine the conservation of wild relatives of plants with agricultural production, to promote the sustainable development of conservation of wild relatives of plants, and increase the income of farmers. In addition, many state key projects are implemented, such as Studies on Discovery of Gene Resources for Agriculture and Innovative Utilization of Germplasm which is supported by science and technology in the Eleventh Five- year Plan, "973" programme of Basic Research on Genetic Composition and Using Efficiency of Main Crop Parents, Survey of Agro-biology Germplasm Resources in Yunnan and Around Areas and Survey of Crop Germplasm Resources with Drought Resistance and Saline-Alkaline Tolerance in Coastal Areas. All these have greatly promoted the conservation and utilization of plant genetic resources for food and agriculture in China.

5.2 Training on Plant Genetic Resource for Food and Agriculture

With the implementation of national plan on conservation and utilization of plant genetic resources for food and agriculture in China, the quality demands for persons in charge of management and scientific research work and for social public are increasing. To this end, the Chinese government has drawn up special training plan and appropriated specific funds for enhancing the training work.

In the past decade, China Ministry of Agriculture has organized or trusted local agricultural departments, agricultural research institutions and agricultural colleges to organize training courses (or workshops) more than hundred times, and disseminated the significance of protecting plant genetic resources for food and agriculture by broadcast, TV, news papers,etc. it has improved the management levels and public awareness. In December 2002, two training courses on the protection and management of wild agricultural plants were held by the Ministry of Agriculture in Xining City, Qinghai Province and Yichang City, Hebei Province respectively. The management persons and technicians from 31 provinces, municipalities and autonomous regions and model units on protection of wild crop plants attended the training course. In December 2002, the Ministry of Agriculture and Agricultural Broadcasting School jointly held the long-distance training course on Ecological agriculture and Sustainable Development of Rural Areas. In October 2006, Guangxi Zhuang Aotonomous Region held training course on Regulations of the People's Republic of China on Administration of Import and Export of Endangered Wild Animals and Plants in Nanning. In October 2007, the Chinese Academy of Agricultural Sciences held the training course on Image Cellection and Processing of Plant Germplasm Resources. It has improved the quality of collecting images of resources. In April 2008, the Ministry of Science and Technology held the training course on Survey of Plant Genetic Resources, with the purpose of keeping the survey data accuracy and scientificalness. In April 2008, the Ministry of Agriculture held the training cause on Management of Plant Genetic Resources. More than 120 participants from agricultural sectors at provincial level and research and education agencies attended the course. The course has gained good results.

With the support from the Chinese Government, we have through different sources disseminated the importance of plant genetic resources for food and agriculture, disseminated and implemented relavant laws and regulations， held training course on farmer participatory protection of plant genetic resources for food and agriculture. All these have greatly increased the public consciousness on the protection of plant genetic resources for food and agriculture in the whole society and powerfully promoted the work on conservation and utilization of plant genetic resources for food and agriculture in China.

5.3 Establishment of Law Systems on Plant Genetic Resources for Food and Agriculture

5.3.1 Issuing Laws and Regulations

Since 1996, the Chinese Government issued a series of laws on plant genetic resources, such as Seed Law of the People’s Republic of China（2000）, Animal Husbandry Law of the People's Republic of China （2006）, of which, Seed Law of the People’s Republic of China stipulates that the country will protect its germplasm resources by law, and forbid to collect or cut natural germplasm resources which are natural germplasm resources under the key protection by the state. The State has made plan in collection, documentation, identification, registration, conservation, exchange and utilization of germplasm resources. Agricultural and forestry authorities under the state council should establish national gene banks, protection districts or protection areas.

5.3.2 Formulating Relevant Rules and Regulations

According to the requirements of conservation and sustainable use of agricultural bio-diversity, the State Council and relevant ministries and commissions have formulated a series of rules and regulations. They have promoted the work on conservation of agricultural bio-diversity.

Regulations of the People's Republic of China on Wild Plants Protection（1996） stipulates that all units and individuals shall have the duty to protect wild plant resources. All units and individuals shall be forbidden to illegally collect wild plants or damage the environment for their survival. Districts with a natural concentrated distribution of species of wild plants under special state or local protection shall be designated as nature reserves. Measures should be taken to save the wild plants under special state and local protection when their growth is endangered, when necessary, it should build reproduction bases, gene banks or move the wild plants to other places for protection.

The ordinance on agriculture transfer-gene biology safe administration（2001）stipulates that agriculture transfer-gene biology safe should not only prevent from damages to human, animals, plants and microorganism, but also prevent from potential risks for ecological environments. The Ordinance has made clear prescribes for the activities on research, experiment, production, processing, business, import and export of agriculture transfer-gene biology. According to the damage degrees, the agricultural transgenic living things have been divided into I, □, □ and □grades and they will be managed at different levels.

Measures for the Administration of Crop Germplasm Resources（2003）clearly indicates that the government will follow the law and regulation to protect and monitor the activities on collection, documentation, idtification, conservation, exchange, utilization and management of crop germplasm resources. Any unit and individual should not occupy or destroy germplasm resources. Administrations of agriculture and forestry in the State Council should establish national gene banks, protection zones or protection sites for germplasm resources. They have formulated the regulations for collection, documentation, idtification, conservation, exchange, share and utilization of crop germplasm resources. Meanwhile, they have also drawn up the detailed rules for the management of national gene banks (nurseries), established a unified code system for plant germplasm resources, evaluation and registration system for elite germplasm resources, and the system for distribution and utilization of plant germplasm resources. They have also established a sound system on the policy and regulation of plant germplasm resources. All these have laid a foundation for efficient management and utilization of plant germplasm resources in China.

5.3.3 Agencies Establishment

In 2001, the Ministry of Agriculture established a Leading Group for Protection of Wild Agricultural Plants，it will be responsible for putting forward the countermeasures and principle opinions to solve some key problems on protection of wild crop plants, coordinate management and coordination of law on protection of wild plants, draw up the plan and programme on protection of wild plants in the whole country, propose important measures for protection of wild plants by the Minstry of Agriculture, and provide guidance to agriculture, animal husbandry and fishery sectors at all levels for law implementation in protection of wild plants.

In 2003, the Ministry of Agriculture established a leading group on agriculture transfer- gene biology safe administration and set up a Office for the Safety Control of Agricultural Transgenic Living Things；An inter-ministerial joint meeting mechanism on the safety of transgenic products has been established, which consists of responsible persons from the Ministries of Agriculture, Commerce, Health, Science and Technology, General Administration of Quality Supervision, Inspection and Quarantine, State Environmental Protection Administration. The State Committee for the Safety of Agricultural Transgenic Living Things established in our country shall be responsible for assessing safety of agricultural transgenic living things.

In 2004, the Ministry of Agriculture and the Bureau of Forestry jointly established China Wild Plant Conservation Association (CWPCA) The philosophy of Association is that under the direction of state guidelines on wild plant protection to unite social forces, publicize the state policies, laws and decrees, popularize the knowledge of wild plants, increase the consciousness of protecting wild plants of the whole nation, efficiently protect and rationally use wild plant resources in China, and promote the development of wild plant protection cause in China.

5.4 Requirement Evaluation and Priority Development

By 2020, China will continue to support the implementation of national plan on plant genetic resources for food and agriculture, intensify the input, put the emphasis on 20 priorities mentioned in The Global Plan of Action, conduct systematic investigation, safe protection, identification and evaluation, enhancement and utilization of plant genetic resources for food and agriculture and discover new genes. We will enhance the propagation and training on social and public consciousness of protecting plant genetic resources for food and agriculture, intensify the technical training on conservation and utilization of plant genetic resources for food and agriculture, continue to conduct the training course on the management of plant genetic resources for food and agriculture, continue to perfect relavant laws and regulations on plant genetic resources for food and agriculture, establish coordinating machenism for plant genetic resources for food and agriculture, and establish management system for plant genetic resources for food and agriculture at city and county levels.

Chapter 6　Regional and International Cooperation

Since the natural environments and climate conditions varies in each country, original or introduced plant genetic resources have their own characters. The long history of the world agricultural development has proved that no country can solve alone the problems on plant breeding and agricultural production by relying on its own plant genetic resources. Meanwhile, the damage or extinction of plant genetic resources in any countries will influence the survival and development of the whole mankinds. Therefore, strengthening regional and international cooperation and safe conservation and sustainable use of plant genetic resources is an obligation and responsibility for each government, non-governmental organizations, enterprises, institutions and each citizen.

China is rich in plant genetic resources. The Chinese government has attached great importance to the conservation, research and utilization of plant genetic resources, meanwhile, also attached great importance to the conservation and utilization of plant genetic resources both in our country and the world by conducting regional and international cooperation. In the past decade, China has provided a lot of plant genetic resources to abroad, The Chinese Academy of Agricultural Sciences alone has provided 11288 accessions of 120 species to over 100 countries or international organizations, such as USA, UK, the Philippines, IRRI, CIMMYT. By introduction and exchange of these genetic resources, it has played a great role in plant breeding and agricultural production in the world.

In order to safe conserve and sustainable use of plant genetic resources in the world, we have actively established collaborative network with other countries, signed international agreements. Through participating in international projects, they have promoted the system establishement of conservation and utilization of plant genetic resources in the world.

6.1 Actively Participating in International Collaborative Network and Promoting Common Development of Plant Genetic Resources in the World

6.1.1 Collaborative Network on Crops

The Chinese government has encouraged agricultural research institutions to actively participate in international collaborative network on crops for conservation and utilization of plant genetic resources. Through the activities conducted in the network, it may promote the links among the countries and strengthen the exchanges of plant genetic resources and techniques.

China National Rice Research Institute and other institutions have participated in IRRI's International Network for the Genetic Evaluation of Rice (INGER), provided with 560 accessions of rice resources to some organizations concerned, and participated in global evaluation and utilization of rice germplasm resources. Meanwhile, China has also introduced more than 6000 accessions of rice germplasm resources from other countries through this network. By using of germplasm resources obtained from INGER, some research organizations in China have developed a lot of rice varieties; the sowing area of these varieties is over 15 million ha. the yield has increased by 5.5 million tons.

On behalf of China, Guangdong Academy of Agricultural Sciences has joined the the International Network for the Improvement of Banana and Plantain (INIBAP). It has made surveys on banana germplasm resources in Guangxi Zhuang Autonomous Region and Yunnan and Hainan provinces. The collections have been duplicated in Zhanjiang, Guangdong Province for conservation. The identification data on collections will be provided to INIBAP and be entered into Musa Germplasm Information System.

Coconut Research Institute of the Chinese Academy of Tropical Agricultural Sciences (CATAS) has participated in International Coconut Genetic Resources Network (COGENT). Since 1997, the Institute has conducted some projects on collection, identification and conservation of coconut resources. Through intercropping and *in situ* conservation, it has increased the incomes for the coconut farmers.

6.1.2 Regional Collaborative Network

East–Asia collaborative network for conservation and utilization of plant genetic resources includes China, Japan, Korea, Republic of Korea and Mongolia. On behalf of China, the representatives from the Chinese Acaemy of Agricultural Sciences have participated in the activities organized by the Network. Through the network, some research organizations such as Institute of Crop Sciences of CAAS and Guangxi Academy of Agriultural Sciences have conducted following research work on survey, identification and evaluation of red bean, collection and identification of millet and broom millet resources, and collection, identification and protection of jobstears. East Asia collaborative network for conservation and utilization of plant genetic resources has strongly promoted the cooperation between the countries in East Asia.

6.1.3 Network on Large Collaborative Projects

Challenge plan is an international research plan on crop genetic resources and is sponsored by CGIAR and some developing countries. China is one of the sponsor countries and also an important partner. The Institute of Crop Science of CAAS has participated in several projects on the identification of diversity of crop germplasm resources in the Plan, including the resource evalution of rice, maize, wheat, barley and grain legume and discovery of elite genes. Since the project has formed a network link, it has greatly promoted the exchange and share of germplasm resources and has played an active role in discovery of elite genes and their use.

With the support from Asia Development Bank, the countries concerned in Asia and the Pacific jointly initiated a project on study of Conservation and Utilization of Tropical Fruit Trees in Asia. The organizations like Citrus Research Institute of CAAS, the Chinese Academy of Tropical Agricultural Sciences, Guangdong Academy of Tropical Agricultural Sciences have participated in such project. They have conducted some activities, including collection, evaluation and conservation of germplasm resources of citrus, mangoand lichi and establishment of data for them. Through this project, these Chinese research organizations have established close links with partner organizations of foreign countries concerned, conducted the exchanges of technologies and information, and promoted the cooperation among the countries.

6.2 Widely Conducting Cooperation between Countries and Promoting Exchange and Share of Plant Genetic Resources

The Chinese Academy of Agricultural Sciences and othe Chinese agriculyural research institutions have established wide relations with relavant agricultural research organizations in foreingn countries, shch as Brazil, Russia, Australia, France, Uruguay, etc. The Chinese Academy of Agricultural Sciences has signed memorandums of understanding on exchange of crop germplasm resources with Uruguay Instituto Nacional de Investigacion Agropecuria (INIA), Bulgarian National Centre of Agricultural Sciences (NCAS), etc.

6.2.1 Exchange, Identification and Evaluation of the Resources

Through the cooperation among the countries, it has promoted the exchange of crop genetic resources. We have jointly conducted the identification and selection of advanced resources to promote the utilization and development of genetic resources. By cooperation with N.L.Vavilov All-Russian Research Institute of Plant Industry, the Institute of Crop Sciences of CAAS has regenerated 800 accessions of Russian wheat resources. Heilongjiang Academy of Agricultural Sciences has also made cooperation with the organizations concerned in Russia on the exchange of germplasm resources, such as wheat, soybean, maize, potato, *Hippophae fhamnoides* L.、cucumber, flax, etc.. In the cooperation with the USA, China has provided with 500 accessions of local varieties of soybean. China and the USA have jointly conducted the evaluation for them and selected somr excellent soybean resources with resistance to soybean cyst nematode. They have played an important role in breeding. China and Australia have jointly conducted the identification and exchange of edible bean resources. Both sides have exchanged more than 600 accessions of germplasm resources of faba bean and pea, and have collected 95 accessions of faba bean and pea for each in Yunnan and Qinghai provinces. We have provided Australia with 298 accessions of pea and 95 accessions of faba bean and introduced 602 accessions of pea resources and 305 accessions of faba bean varieties (lines). Through identification, we have selected some varieties of faba bean and pea which are suitable for growing in China, they are now cultivated in northwest and southwest parts of China. The yield and quality of faba bean and pea has been increased.

6.2.2 Scientific Exchanges and Training

By exchanging scientists and conducting scientific exchanges with Brazil, Russia, Argentina, the USA, Korea, etc, it has efficiently promoted the mutual understanding, improved the collaborative relations and promoted the exchang of germplasm resources.

Huazhong Agricultural University has held the training courses on molecular identification of germplasm resources for the researchers from developing countries. The Fruit Tree Research Institute of Hebei Academy of Agricultural Sciences has helped train some technicians from Southeast Asia countries on cryopreservation of germplasm resources.

6.3 Signing and Joining International Agreements and Promoting the Construction of Multilateral System on Plant Genetic Resources

6.3.1 Convention on Biological Diversity

China is one of the countries to sign and approve Convention on Biological Diversity. China holds a serious attitude in implementation of the Convention. According to the objectives mentioned in Convention on protection and sustainable use of bio-diversity and equitable benefit – sharing, we have actively conducted a series of activities both at home and abroad on implementation of the Convention, and established Coordination Working Group for implementation of the Convention which is headed by the State Environmental Protection Administration and joined by more than 20 departments. We have published the Country Report of the Bio-Diversity in China, formulated the Action Plan of Biodiversity Conservation in China, and strengthened the legislation building. The legal system on protection and sustainable use of biodiversity has been improved and perfected increasingly. All these have promoted the *in situ* and *ex situ* conservation of biodiversity, intensified public propagation, education and training, and efficiently protected the biodiversity in China.

6.3.2 International Treaty on Plant Genetic Resources

China has not yet joined International Treaty on Plant Genetic Resources for Food and Agriculture, but the Chinese government has recognized the importance of the Treaty, and agreed with the targets setting in the treaty, i.e.promoting the conservation and sustainable use of plant genetic resources for food and agriculture, fare and rational share the benefits produced by using of these genetic resources, and finally realize the safe and sustainable development of agriculture. The Chinese government supports the Treaty to establish multilateral system, and assumes by use of “standard material transfer agreement (SMTA)”to access genetic resource and share the benefits.

6.3.3 International Union for Protection of New Varieties of Plants

On April 23, 1999, China joined 1978 text of International Union for the Protection of New Varieties of Plants（UP0V） and has become thity nineth member country of UP0V. China abides by the purposes of UP0V and recognizes the rights of breeders and their lawful successors whom are up to the condtions of new varieties of plants. So far, China has published seven sets of new varieties with 74 genus(species) which have been put into the list of new varieties of plants for protection (exception of forest). The protection of new varieties of plants has significantly proteced the legal rights of breeders, aroused the enthusiasm of breeders and promoted the development of breeding cause.

6.3.4 The Global Environment Facility (GEF)

The Global Environment Facility (GEF) has played an important role in protecting biodiversity. Since the establishment of GEF, China has received great support from GEF. In the fields of agricultural biodiversity, it supports China to protect wild relatives of crops, including wild wheat relatives, wild rice and wild soybean. In recent years, with the support from GEF, we have launched a project on the use of crop genetic diversity to control diseases and pests and to promote the sustainable development of agriculture. By taking different kinds of intecropping and mixed cropping patterns in rice, maize, barley, faba bean，It has efficiently controlled the occurrence of diseases and pests, reduced the use of pesticides, decreased the cost of production, increased the farmers income, and is favorable to protect the environment. Such work has been conducted in 6 trial sites located in Yunnan, Sichuan and Guizhou provinces. After obtaining experience, it will be popularized in large scales.

6.4 Strengthening cooperation with International Organizations and

Promoting Conservation and Utilization of Plant Genetic Resources

China has strengthened the cooperation with international organizations in the fields of plant genetic resources. By 2007, more than 50 research institutes in China have made cooperation with 11 research centers of CGIAR. Trusted by the Ministry of Agriculture, CAAS has signed a series of understanding memorandum for scientific cooperation with most of research centers of CGIAR. At present, ten research centers of CGIAR have established their offices in CAAS, three centers have established joint laboratories with CAAS, such as CAAS-Bioversity Agricultural Biodiversity Center, CAAS-ILRI Pasture Resources Laboratory.

6.4.1 Collection and Introduction

With the support from international organizations, some institutions concerned in China have launched several campains on exploration and collection of plant genetic resources, including cereal crops, fruit trees, coconut, aquatic vegetables, medical plants and oil-bearing plants. More tha 5000 accessions have been collected. China has obtained more than 10000 accessions of wheat genetic resources from CIMMYT, 9421 accessions of rice cultivars and 1574 accessions of wild rice resources from IRRI,，3958 accessions of potato germplasm resources and 839 accessions of sweet potato resources from CIP. Guangdong Academy of Agricultural Sciences has introduced 1500 accessions of peanut resources from ICRISAT, and identified 226 accessions with high resistance to rust and 49 accessions with high resistance to bacteria wilt.

6.4.2 Identification and Evaluation

By the cooperation with CGIAR, agricultural research institutions concerned in China have identified some crop germplasm resources, such as buchwheat and safflower (*Carthamus tinctorius* L.)，the data has been put into the database. The Institute of Crop Science of CAAS and Bioversity have jointly conducted the research on genetic diversity of buckwheat resources, by using of ISSR and AFLP molecular markers, we have analyzed the diversity of bitter buckwheat (*Fagopyrum Tataricum*) from different parts of China, identified the relations between bitter buckwheats from different geographic conditions, and built evaluation system for bitter buckwheat. By cooperation with Bioversity, Germplasm Resources Laboratory of Guanngxi Academy of Agricultural Sciences has conducted the research on genetic diversity of job's-tears resource, and has made the evaluation of agronomic characteristics and molecular evaluation of genetic diversity for job's-tears resources from China, Japan and Korea. The Academy has evaluated the diversity of job's-tears resources with AFLP and SSR markers.

6.4.3 Research on Regeneration and Conservation Techniques

Bioversity and some Chinese organizations have jointly conducted the research on regeneration method and conservation techniques for different crops. The Institute of Crop Sciences of CAAS has conducted research on germplasm regeneration methods for buchwheat, Job'-tears, Chinese cabbage, multiflora bean and sesame, the study on ultra-dry preservation of seeds. Changli Fruit Tree Research Institute in Hebei Province has conducted the study on cryopreservation technique for temperate fruit tree resources and has gained success in apple, pear, grape and Chinese gooseberry. Chengdu Biological Research Institute of the Chinese Academy of Sciences has conducted the research on the possibility of on farm conservation of bitter buckwheat (*F.tatar-icum*) at Liangshan Yi Aotonomous Prefecture in Sichuan Province, and evaluated the genetic resources diversity of bitter buckwheat in varying agroecological conditions and the role of agricultural communities in conservation of bitter buckwheat germplasm resources.

6.4.4 Distribution and Utilization

By the cooperation with Bioversity, the Oil Crops Research Institute of CAAS has evaluated the diversity of 4251 accession of sesame genetic resources and established core collection which is consited of 453 accessions of sesame resources. By the cooperation with Bioversity, the Institute of Crop Sciences has made a survey on the utilization of genetic resources conserved in national gene banks. The results show that 21% crop germplasm resources distributed from gene banks have been used for identification and evaluation, 8% for breeding and 9% for basic research.

By cooperation with Bioversity, Yunnan Agricultural University, Sichuan Academy of Agricultural Sciences, Guizhou Academy of Agricultural Sciences and other institutions have jointly conducted the research on the use of genetic diversity to control diseases and pests and to promote the sustainable development of agriculture. By introducing different kinds of planting patterns and using of local varieties of rice, maize, barley and faba beans in production, they have efficiently controlled the occurrence of diseases and pests，reduced the dosage of chemical pesticides，increased the farmers' income, and protected the genetic diversity and agro-ecological environment.

6.4.5 Information Service and Management

In the past decade, CGIAR has provided a large number of free-charge books on science and technology and technical materials to the Chinese partners. Many important technical books have been translated into Chinese for distribution. Many scientists who engaged in germplasm resources have benefited from them. Particularly, Bioversity and some institutions in China have jointly developed a series of software system for management of germplasm data, published E – list of germplasm resources and software system on searching the information of seed storage behaviour. They have been distributed and used worldwide.

6.4.6 Capacity Building in Germplasm Resource Management

With the support from CGIAR, a series of training courses have been hold in China, more than 100 scientists have been trained in genetic resources, of whom, more than 30 scientists are women. Over 50 scientists have been trained in abroad， it has greatly improved the capability in the management of plant genetic resources in China.

6.5 Requirements Evaluation and Priorities for Development

Through international cooperation, we have established a platform for exchange of information on plant genetic resource, understood the new development of plant genetic resources in the world, and promoted the conservation and sustainable use of plant genetic resources in China. With the coordination by FAO, we have developed the technical methods for *in situ* conservation of plant genetic resources, especially for wild resources, and on farm conservation of local varieties, and established an early warning system. We will further mobilize the funds for crop diversity and expand funding scope and strength, and promote the regeneration, conservation and utilization of plant genetic resources.

Chapter 7 Access to and Benefit Sharing from Plant Genetic Resources and Farmers' Rights

Some international laws and policy frameworks on access to, utilization and sharing of plant genetic resources for food and agriculture have been established, such as Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture. The Chinese government is also developing or amending domestic laws or regulations to facilitate the access to and benefit sharing from plant genetic resources and protect farmers' rights.

7.1 International Laws and Policy Frameworks on Access to and Benefit Sharing from Plant Genetic Resources

Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) clearly defined that States have sovereign rights over their own biological resources. Each contracting party should, subject of its natioanl legislation and on the prior informed consent, create conditions to facilitate access to genetic resources by other contracting parties, ensure the fair and equitable sharing of benefits and realize the farmers' rights. The ITPGRFA defined that contracting parties shall sign Standard Material Transfer Agreement (SMTA) in the exchange of plant genetic materials. If contracting party commercializes the material or materials accessed from the Multilateral System, the contracting party shall pay one point-one percent (1.1%) of the sales of the material or materials less thirty percent (30%) to financial mechanism established by the governing body of ITPGRFA for the conservation and utilization of plant genetic resources. In addition, ITPGRFA also defined that recipients of genetic resources shall not claim any intellectual property that limit the third party to further research and use for original materials or their genetic components obtained under the Multilateral System

7.2 Current Status, Existing Problems and Solutions on Obtaining Plant Genetic Resources in China

China signed the CBD in 1992, and established a Coordination Group led by the Ministry of Environmental Protection involving over 20 departments to actively engage in international cooperation, and promote resources acquiring and benefits sharing. So far, China has not singed the ITPGRFA, however China has attended all negotiations on ITPGRFA. The Chinese government consents and supports the principles of facilitate access to genetic resources and benefits sharing, and has been striving to promote exchanges of plant genetic resources and to make contribution to food security and sustainable agricultural development in the world..

At present, China has not established legal systems specific for plant genetic resources acquiring and sharing, but some existing laws and regulations have some provisions for plant genetic resources exchange. For example, the Chapter 2 of Seed Law-"germplasm resources protection"- has provided some related regulations for protection, collection, management, and exchange of germplasm resources and set up an administrative approval system for providing germplasm resources to abroad. Measures for the Administration of Crop Germplasm Resources, released by the Ministry of Agriculture in 2003, detailedly regulated activities on crop germplasm resources in terms of collection, characterization, evaluation, documentation, conservation, exchange, utilization, management, and so forth.

The Chinese government and relevant institutions have been always striving to facilitate access to genetic resources, and signed agreements related to the exchange of plant genetic resources with many countries. For example, in 2002, China Ministry of Science and Technology of and the USDA signed a Protocol on Cooperation in Agricultural Science and Technology, which included an Agreement on Promoting the Exchange of Plant Genetic Resources, for the purpose of promoting the exchange and sharing in the field of plant genetic resources. The Chinese government has been actively encouraging Chinese research institutions to exchange plant genetic resources with foreign counterparts. For example, the Chinese Academy of Agricultural Sciences (CAAS) has signed a series of the agreements with its counterparts of other countries including Russia, Brazil, Argentina, Australia, France, Asean, Uruguay, in which, the genetic resources exchange is one of the core parts for cooperation. In the past 10 years, through exchanges of germplasm resources, the Chinese institutions introduced about 30,000 accessions of plant genetic resources, and provided over 40,000 accessions to other countries. Genetic resources received are mainly used for cooperative evaluation, parental material screening, and genetic diversity research

Although a lot of effort has been made in promoting access to plant genetic resources by international community, the difficulty in acquiring germplasm is increasing. Especially after the Convention on Biological Diversity was entered into force, many countries had set up laws and regulations to protect their own plant genetic resources. They have restricted the export and exchange of genetic resources. In addition, since there are lack of effective mechanisms and practical procedures for genetic resources acquiring and benefits sharing, in particular the divergenece of view in ownership, taking modes and conditions, benefits sharing equity of genetic resources at international community. They have restricted the taking and exchange of genetic resources worldwide.

Obviously, the difficulty to introduce foreign genetic resources, especially those not originated from China, has been increasing. For the purpose of promoting access to genetic resources, China has considered the possibility to join the CBD Multilateral System, thus we may have more opportunities to obtain the resources. At the same time, China will strengthen regional and bilateral collaboration and conduct the exchange of genetic resources. Through joint exploration, evaluation and varieties improvement, the genetic resources should be shared within the partners

7.3 Current status, existing problems, and solutions of plant genetic resources benefits sharing

The profits of plant genetic resources can only be made after they become products and are commercialization. By using genetic resources to develop news varieties tremendous economic value could be revealed. For example, by using wheat germplasm Aimengniu in breeding units of China, nearly 20 new wheat varieties have been developed. These new varieties have played an important role in production and have produced millions economic benefits. Genetic resources not only create tremendous economic value, but also play an immeasurable role in biodiversity enrichment, environment protection, and national cultural heritage.

In China, plant genetic resources are state-owned, and the governmental departments and research institutions have the right to manage genetic resources. But farmers are the direct beneficiaries of plant genetic resources because new varieties developed from genetic resources have increased production, improved the quality, and raised the income of farmers. Many landraces and wild relatives have played significant role in developing modern varieties. The farmers who are in charge of protection of landraces and wild relatives can benefit from technological information, training, economic compensation and planting new varieties.

In existing laws or regulations, there are no benefits sharing mechanisms for economic development of genetic resources. So the benefits sharing mechanisms of genetic resources are developed automatically and have two forms. One is developed in the process of large-scale cooperative programs. By signing agreements, cooperative parties may identify benefit sharing proportion for genetic resources providers. Thus they can equally share the benefits arisen from cooperative programs. The other is developed between providers and users of genetic resources. By signing agreements, contracting parties may clarify responsibilities and benefit sharing modes or proportion.

Although preliminary explorations of benefits sharing mechanisms have been made, there are still many problems in the course of operation. For example, most provisions are a matter in principle, and lack of strong legally binding and operability; in many cases, it is difficult to identify the products, degree of their commercialization, and the proportion of genetic resources in products. Benefits raising from genetic resources have to undergo a very long time, which make it difficult to protect the effectiveness of benefit-sharing agreements; some users of genetic materials are reluctant to give feedbacks, so it is very difficult to track and share the benefits.

Plant genetic resources acquiring and benefits sharing are prerequisite to plant breeding and fundamental guarantee for sustainable agricultural development. The departments concerned attach great importance to issues on plant genetic resources acquiring and benefits sharing, and have been actively taking measures to improve genetic resources taking and benefits sharing. For example, by improving relevant laws, regulations, and policy system, it has promoted plant genetic resources acquiring. By developing effective acquiring mechanism, it has facilitated access to the genetic resources. The Chinese government will continue to intensify the input to multiplication and regeneration of plant genetic resources for mid-term gene bank. Thus, it will lay a foundation for utilization. We should develop more practical and effective benefits sharing mechanism encourage relevant institutions in China to conduct equal exchange of materials with foreign counterparts, collect feedback information on the use of resources, and realize benefits sharing of commercialization.

7.4 Implementation of Farmers' Rights and Recommendations

International communities attach great importance to the farmers' rights for the purpose of acknowledging their tremendous contributions in the course of protecting plant genetic resources for food and agriculture. CBD has strived to seek the solutions to farmer's rights, especially to issues on access to plant genetic resources conserved under *in situ* conditions and benefits sharing. ITPGRFA has formally recognized the rights of farmers in provisions, and stressed that it should be implemented farmers' rights at international and national levels. In general, the rights include: (1) protection of traditional knowledge relevant to plant genetic resources; (2) the right to equitably participate in sharing benefits arising from the utilization of plant genetic resources; (3) the right to participate in making decisions, at national level, on matters related to the conservation and sustainable use of plant genetic resources; (4) the right to conservation, propagation, sale of local varieties; and (5) the right to use breeders' varieties and take genetic materials from genetic resources conservation centers.

China remains in the initial stage in the implementation of farmers' rights. Although the importance and necessity of farmers' rights was recognized and policies and measures were under research, there are still some difficulties. One is that there are no existing laws to clarify farmers' rights, and no legal basis for implementation; the other is that the theory for farmers' rights have not been fully developed, and the subject, scope, content and achieving mode of farmers' rights are not clear. China is a developing country, and is also an active supporter for farmers' rights. The Chinese government is considering making farmers' rights be implemented by protection and utilization of plant genetic resources and traditional knowledge.

In order to actively promote the implementation of farmers' rights, we recommend that first, we should integrate farmers' rights into the areas of plant genetic resources management; second, we should establish or amend existing laws, recognize farmers' rights, and define the subject, scope, content and achieving mode of farmers' rights; third, we should establish feasible ecological compensation system, promote *in situ* conservation of plant genetic resources and maintain the rights and interests of local farmers.

Chapter 8 Contribution of Management of Plant Genetic Resources for Food and Agriculture to Food Security and Sustainable Development

Plant genetic resources for food and agriculture is a strategic resource for the survival and development of the human society, and is an important guarantee for increasing overall agricultural capacity and maintaining the state food security. Therefore, by strengthening the management of plant genetic resources for food and agriculture, exploring and utilizing the excellent characteristics and excellent genes contained in these resources, it can promote the rapid development of plant breeding, scientific research and agricultural production, and will make an important contribution to food security both in China and the world, economic development, poverty elimination and agricultural stability.

8.1 Contribution to Food Security in China

The management of plant genetic resources for food and agriculture has made great contribution to food security in China. Particularly since the reform and opening-up to outside world from 1978 , by directly using of plant genetic resources for food and agriculture, more than 6000 new varieties and combinations of crops have been developed in China, of which, 2297 crop varieties have been examined and approved by the State. Some varieties of staple crops including hybrid rice, cotton and oil bearing crops have been replaced 4 to 6 times in the whole country. The yield has increased by 10％ and more for each replacement. According to the estimates made by experts that when crop yield increased by 10% each time, the poor people living on less than one dollar per person per day will reduce by 6%～8%. The efficiency use of plant genetic resource for food and agriculture in China has not only played an important role in increasing the yield of crops, improving the quality of farm products and optimizing the structure of planting, but has also played significant role in increasing farmers income, ensuring the supply of farm products and reducing the poverty.

According to statistics that from 1949 to 2007, the yield of grain crops increased from 1050kg/ha to 4400 kg/ha in China, the total production increased from 113.2 billion kg to 501.5 billion kg., raised by 4.2 times and 3.8 times respectively, of which, the yield of rice increased from 1890 kg/ha to 6383 kg/ha.The yield of wheat has increased from 630 kg/ha to 4765.5 kg/ha. The extended areas of hybrid maize have accounted for 70%～80% of the planting areas of maize. The yield has increased from 1335 kg/ha to 5393kg/ha. At present, the coverage rate of major improved varieties of crops has reached 95% and more, their contribution rate to crop yield is near 40%. This shows that plant genetic resources for food and agriculture are the strategic resources for food security both in China and the world.

8.2 Contribution to the Development of Rural Economy

The conservation and utilization of plant genetic resources for food and agriculture in China has promoted rapid development of rural economy which relies on processing of farm products. It has not only improved the quality of farm products, increased the value of farm products and the income of the farmers, but has also absorbed large surplus rural labor force. Since 2000, the industrial structure and product structure of farm product processing industry have been adjusted gradually and a farm product processing industrial structure dominated by grain, oils, fruits, vegetables, animal products and aquatic products has been formed, of which, proportion of food industry has increased.. The production value of food industry reached 50％ in that of farm product processing industry in 2005. The structure of products is toward diversification. The added-value of products has increased gradually. The deep processing rate of major farm products has reached over 30％, and it has shifted from primary processing to deep processing.

The average annual value of farm product processing industry in China has raised by near 15％. It has reached 4,200 billion yuan in 2005. According to estimates by experts that the value of farm product processing industry in China will break through 7000 billion yuan in the year 2010. In the end of Eleventh Five-year Plan, the rate between the value of farm products processing and the value of agriculture will be over 1.5：1.

In the agriculture-based counties(cities), the contribution rate of the revenue of farm products processing to their finance has reached 70％. By establishment of beneficial link mechanism of company + base + household, company + intermediary organization + household and company + village committee + household, the farmer' income has increased. At present, there are about 70000 farm product processing enterprises with annual sale value over 5 million yuan in the whole country. Of which, there are about 580 leading enterprises of agriculture industrialization, they have made 8726 households benefit, accounting for 35.2% of total ones in China. Annual average income of households which have participated in industrialization operation has increased by 1300 yuan than that of ordinary households. With the development of farm product processing industry, it is certain that higher requirements on plant genetic resources for food and agriculture will be needed.

8.3 Contribution to eliminate poverty

In order to solve poverty problems for 64 million people in China, one of important measures we take is to play the role of important cash crops and special crops in particular areas by the management of plant genetic resources for food and agriculture. In some poverty areas in west part of China, such as in Qinghai, Gansu, Guizhou and Yunnan provinces, by make great effort to develop cash crops which are suitable to grow there, we have obtained good results.

Haidong Prefecture of Qinghai Province has changed its planting structure from dual structure of food crops and cash crops to four-element structure of food crops, cash crops, frorestry and pasture, and animal husbandry. In Bijie Prefecture of Guizhou Province, the situation has changed from competing the farmland between forests and crops to a flourishing for forest and bumper, harvest for crops，the grain yield in whole Prefecture has increased from 2.22 million tons before returning farmland to forests in 1999 to 2.47 million tons in 2007, increased by 11.4％, the annual average net income of farmers per capita increased by 12.4％. In Xishuangbanna and Simao Prefectures along the Lantsang valley in Yunnan Province, we have established demonstration projects for planting and processing of tropical fruits and cash crops, with annual production value of 37.5 milion yuan，20000 farmers at local place have wiped out poverty. 100000 farmers have benefited indirectly. By sufficient use of mountainous areas and woodland resources in communities at Wen County and Wudu County in Gansu Province, we strive to develop labour intensive industry and farm product processing industry, such as medicinal materials and tea, with the purpose of increasing added-value products and helping the farmers to benefit directly from them. By developing special farming in Sanya area of Hainan Province, such as areca, rubber, coconut and mango, they have increasd the proportion of cash crops in farming, and have primarily realized the objectives of casting off poverty and setting out a road to prosperity.

According to the statistics that the economic benefits of cash crops and special cash crops in particular areas have been developed rapidly. From 1949 to 2007, cotton varieties were changed six times. The yield increased from 375 kg/ha to 1335 kg/ha. Especially for transgenic insect-resistant cotton which has its own intellectual property, its cultivated areas increased from 7% of total area of cotton in 1999 to 82% of that in 2006, the accumulated area was over 11 million ha， saving pestiside about 45000 ton, more than 30 million householders were benefited. For hybrid rape (Brassica napus L.) variety Qinyou 2 obtained by three-lines breeding, its average yield was over 1830 kg/ha. By using of groundnut germplasm with high resistance to bacterial wilt, we have developed a number of varieties with high-yielding and resistance to bacterial wilt. They have been spread all over the country，annual income increased by 200 million yuan.By using of Hunan local hot pepper varieties as elite parents, we have developed a series of Xiangyan varieties from one to ten which have been extended in 30 provinces and municipalities in the whole country, with accumulated area of 65000 ha. By using of Cucurbita ficifolia Bouch6 as rootstock to graft cucumber, the yield can increase 30%～50%，Such variety has been planted over 14000 ha in the whole country. Since the middle of 1990s, by popularizing series varieties of New Taitang with high-yielding and high sugar contents, the average yield has reached 67.5 ton/ha in Guangxi major sugarcane growing area. It has made great contribution to balance the demand and supply of sugar.

8.4 Contribution to the Stability of Agriculture

Plant genetic resources for food and agriculture are a treasury in supplying good quality varieties in production. When we hold more plant genetic resources for food and agriculture, we have more opportunity to select suitable varieties for production, thus we can scientifically and rationally regionize the crops and make arrangement for varieties. The purpose is to resist various disasters and promote the stable development of agriculture. For example, by using of quality wheat variety Xiaoyan 6 as direct or indirect parents in China, 53 new wheat varieties with good quality, disease resistance and high-yielding have been developed. Accumulated sowing areas are over 20 million ha with increase of yield by 8 billion kg. The economic benefit we created is over 10 billion yuan. By using of elite germplasm, we have developed super hybrid rice, the accumulated sowing areas have reached 14 million ha. in 2000-2005, the yield of rice raised by 12.5 billion kg.

By conducting the research on using biodiversity to control the diseases and pests, Yunnan Agricultural University has found the basic rules by crop-variety diversity to control the diseases. They have developed 5 patent techniques on the use of diversity of rice, maize, potato, wheat and faba bean to control major diseases. These techniques have been applied widely. The accumulated application areas in Yunnan and Sichuan reached more than 240 ha. in 2003-2005.

8.5 Contributions to Scientific Innovation

The Chinese government has also established a sharing platform for national plant genetic resources. The purpose is to promote the sharing and utilization of plant genetic resources for food and agriculture. Through establishing information network, concentrating show the resources in the field, publishing circular on excellent resources and list of resources， we have promoted the sharing of germplasm resource and information, and increased the utilization value and benefit of plant genetic resources for food and agriculture. During the period of 2001 to 2007, 132000 accessions of plant genetic resources for food and agriculture were provided to 2650 units in the whole country. They have been used for developing new varieties, conducting resource research and research on biological science, and have been used in production. They have promoted the innovation of agricultural sciences and technology in China and have generated significant socio-economic benefits.

The significant contribution of plant genetic resources for food and agriculture to the innovation of agricultural science and technology are showing in developing new varieties of super rice, dwarf male sterile wheat, insect-resistant transgenic cotton and hybrid soybean. Of which, when we have sufficiently used wild-abortive cytoplasm and improved wild abortion male sterile line in super hybrid rice, we have also sufficiently explored new male sterile cytoplasm genes. It has laid foundation for the theoretical studies, development of varieties and technical integration of hybrid rice in China. Dwarf male-sterile wheat is a new germplasm which has been created by using Taigu genie male-sterile wheat with dwarf gene through chromosome engineering. Such new germplasm and new breeding techniques has made some elite genes from several wheat parents to get together in a new variety. Thus, it has raised the yield, quality, resiatance to diseases and pests, and tolerance to stress, realized the organic combination of high yielding, good quality and resistance, advanced the breeding efficiency, and can provide new wheat varieties which can meet different kind of demands in agricultural production. Zajiao 1 is the first hybrid soybean variety developed by China in the world. The yield increased by 21.9% than that of check variety. Transgenic cotton with insect resistance has organically combined the resistance to cotton bollworm (Helicoverpa armgera) with the resistance to aphid (aphis gossypii). It is in world advanced level.

8.6 National Requirements and Priorities for Development

It is reported experts that the Chinese people will reach 1.45 billion by year 2020. It needs to increase 90 million tons of grain. To strengthen the management of plant genetic resources for food and agriculture and develop new varieties with high-yielding, diseases and pests resistance, stress resistance and responsive to high levels of fertilizers and water is an efficient way to solve this problem.

The emphasis for the future development is on the capacity building of management for plant genetic resources for food and agriculture. Based upon the existed work, we shuould combine the immediate and medium-term objectives with long-term objectives, muster superior forces all over the country to make overall planning, and conduct basic work, basic research and basic application research on plant genetic resources. We should cosmically conduct deep identification and evaluation of germplasm resources in a large scale, explore new genes with important application perspective，create new germplasm and materials，and lay a firm foundation for plant breeding and sustainable development of agriculture.