中国工程科技知识中心
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《农业水土资源监控研究》专题快报

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【动态资讯】

1．吴孔明调研资源区划所强调：聚焦耕地要害问题 完善科技创新体系

【中国农业科学院】11月12日，农业农村部党组成员、中国农业科学院院长吴孔明到农业资源与农业区划研究所调研指导工作，听取研究所情况汇报，并与创新团队、管理团队座谈。副院长刘现武主持座谈会。院党组成员、人事局局长陈华宁参加调研。吴孔明指出，资源区划所围绕"四个面向"，在解决农业资源与环境领域重大科技问题、服务支撑产业发展方面取得了重要成绩，在学科体系构建、前瞻性基础研究突破、高层次人才梯队打造、科研试验基地布局、创新文化建设等方面成效显著。吴孔明要求，对标"十四五"新形势新任务，资源区划所要把推动科技创新实现高水平自立自强作为根本要求，坚持用新发展理念引领研究所发展。要立足"国之大者"统筹资源，聚焦"耕地要害问题"，进一步加强顶层战略设计，构建完善交叉融合、优势互补、契合需求的土壤和土地科技创新体系。要强化平台与学科建设的系统性、配套性，充分利用现有的学科平台基础，打造国家耕地科学中心，形成耕地科技创新高地，引领学科发展。要加快科技创新与成果转化体系建设，推动创新链、产业链和资本链融合发展，加速集聚人才、技术、资本等创新资源和要素，打造具有重要影响力的科技创新策源地。

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPX6AIUIwAAPfHtzF6vE532.pdf

2．科技创新支撑粮食减损降耗

【农民日报】实践证明，我国应用科技创新成果有效减少了粮食损失，为深入推进粮食供给侧结构性改革，促进粮食"产购储加销"协同保障提供有力支撑。近日，中办国办印发《粮食节约行动方案》，明确了减少粮食损失浪费的任务，更需要科技创新为节粮减损工作提供有效支撑。

3．河北农业年用水量6年下降30亿立方米：这里种地更省水了

【中国农网】为推进农业生产节水，河北积极探索冬小麦节水种植技术，通过选育50多个抗旱节水品种、免费供种到户，同时配套落实农艺节水技术，实现小麦节水稳产。2014年至2020年，河北全省累计推广种植节水小麦3410万亩。一手抓节水种植，减少灌溉次数；一手还要抓节水灌溉，提高灌溉效益。在晋州市槐树镇龙泉固村的悠闲家庭农场，昔日用来浇水的垄沟不见了，取而代之的是一排排水管。推行小麦节水种植、推广节水灌溉、探索旱作雨养种植技术……2014年以来，河北多管齐下推进农业生产节水。

【文献速递】

1．**Synergetic management of water-energy-food nexus system and GHG emissions under multiple uncertainties: An inexact fractional fuzzy chance constraint programming method**

文献源：ScienceDirect,2021-11-18

摘要：Management of water-food-energy nexus (WEFN) is of great importance to achieve the Sustainable Development Goals. The development of WEFN management strategies is challenged by extensive uncertainties in different system components. Also, agricultural activities would contribute a large portion of the total GHG emissions in many countries, which are affecting the promised carbon neutrality in future. In this study, an inexact fractional fuzzy chance constraint programming method was developed towards planning the water-food-energy nexus system under consideration of both uncertainties and greenhouse gases (GHG) emission. An inexact fractional fuzzy chance constraint programming-based water-energy-food nexus (IFFCCP-WEFN) model has been established under consideration of various restrictions and GHG emissions. Solutions of the planting areas for different crops in different periods have been generated. These results imply that the corn cultivation would be prioritized to satisfy cereal demand due to its relatively lower GHG emission intensity. But the residual resources, after satisfying cereal demand, would tend to be allocated to vegetable planting. Comparison has been conducted among the IFFCCP-WEFN model and WEFN models based the inexact fuzzy chance constraint programming approach with and without GHG emissions. The results indicate that, the

results from IFFCCP-WEFN model would achieve a highest unit benefit and lowest total GHG emissions. The total GHG emissions can be 11% less at most than GHG emissions from the resulting crop structures of the other two comparable models. Consequently, the developed IFFCCP-WEFN model can help decision-makers identify the desirable planting structure for crops with a priority of low GHG emission rate. The major contributions in this study include (i) the inexact fractional fuzzy chance constraint programming method to deal with interval and fuzzy parameters, reflect decision makers' preferences and handle conflicts among contradictory objectives, (ii) the IFFCCP-WEFN model to achieve a maximized unit benefit with respect GHG emissions

链接**:**

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPHyAHDCHAGRgnGDgK4c803.pdf

2．Leveraging cloud-based computing and spatial modeling approaches for land surface temperature disparities in response to land cover change: Evidence from Pakistan

文献源：ScienceDirect,2021-11-18

摘 要 ：Monitoring spatial-temporal land use land cover (LULC) patterns and related processes (e.g., land surface temperature—LST) is essential to sustainable development at local, regional, and national levels. In this context, the present study leverages cloud-computing-based Google Earth Engine and geo-information modelling techniques to provide spatial-temporal insights regarding LULC and LST over the past three decades (19902020) in Pakistan—a south Asian country with ～212 million people. Additionally, using Punjab province (the most populous and developed in Pakistan) as the study area, we empirically evaluate the association between several LULC types (i.e., built-up, forests, agriculture, rangeland, barren, and water) and LST. Our results show that due to the transition from rangeland and agriculture LULC to built-up areas (contributing 38 and 37%, respectively), ～250% increase is observed in the impervious surface in Punjab during 19902020. While the rapid urbanization has resulted in ～8.5 percent annual increase in built-up area during the study period, the highest percent change (～10.5%) occurred during the most recent decade (i.e., 20102020). This increase in built-up areas has led to LST rise with 1.4 °C increase in maximum annual LST in Punjab. In addition, among the evaluated top-20 cities, the most significant rise in LST is observed by Kasur city followed by Chiniot, Sheikhupura, Sahiwal, and Lahore—areas known for industrial development in Pakistan. While the results on LULC provide important references for rational and optimal

utilization of land resource via policy implications, the association between LULC and LST ascertains why it is critical to design sustainable LULC planning and management practices for climate change mitigation and adaptation.

链接:

3．Land subsidence and rebound in the Taiyuan basin, northern China, in the context of inter-basin water transfer and groundwater management

文献源：ScienceDirect,2021-11-17

摘要：The freshwater scarcity and sustainability of overexploited aquifers have been recognized as a big threat to global water security for human development. Consequently, much research has focused in the past on negative consequences of groundwater abstraction, but somewhat less has been documented about the impacts of adequate management practices to address water shortages. Here, using an integrated analysis of InSAR displacement data, groundwater, and geophysical modeling we show how combined management provisions and inter-basin water transfer project has affected the aquifer system in Taiyuan basin in North China. Following groundwater recovery, the alleviation of land subsidence was found with rates being reduced by up to ~70% in the period 20172020 with respect to the period 20072010. The increase in pore pressure caused by rising groundwater in Taiyuan city, north of the basin, turned four subsidence centers with rates exceeding 110 mm/yr in the 1980 to uplift centers with rates up to +25 mm/yr between 2017 and 2020. A simple linear elastic model for homogenous subsurface properties can explain InSAR-measured surface displacements well. In the central basin, we found a significant seasonal displacement with annual amplitude up to 43 mm (negative peak in autumn and positive peak in spring) related to the groundwater recharge and discharge due to agricultural pumping irrigation. Using cross-wavelet method, we showed a relatively short time lags (less than one month) between surface deformation and water level changes in the central basin, indicating the low-permeability clayey units have a limited influence in delaying the compaction of aquifer system. Quantifying the effects of adequate groundwater management measures and large-scale engineering approaches like inter-basin water transfer to recharge pumped aquifers provide insight for local governments and decision-makers to properly evaluate the impacts of their policy in recovering the sustainability and efficiency of aquifers in water-deficient basins.

4．Nutrient dynamics in stream water and groundwater in riparian zones of a mesoscale agricultural catchment with intense seasonal pumping

文献源：ScienceDirect,2021-11-17

摘要：Water and soil in agricultural areas are usually enriched with nutrients from excessive fertilizations. Riparian zones, the interfaces between terrestrial and aquatic systems, play crucial roles in delivery of the nutrients to groundwater and surface water. We evaluated spatiotemporal variations of water flow and nutrients in a mesoscale agricultural catchment along the riparian zones of the main stream for dry and rainy season by hydrologic monitoring and measurements of hydrochemical parameters and water stable isotopes. Gaining stream conditions were dominant in the mountainous upper reaches with steep topographic gradient while groundwater level in the lower basin considerably varied seasonally due to intense groundwater pumping to aid in heating greenhouses in winter season, which resulted in losing stream conditions during the dry season. Compared to shallow groundwater, deep groundwater had higher nitrate concentration derived from dry farmland in hilly terrains and induced recharge due to the groundwater pumping. Nitrate concentration was significantly higher in groundwater than that in stream water, indicating that groundwater is a major source of nitrate in stream water considering mainly gaining stream conditions. Compared to stream water, dissolved phosphorus concentration was higher in shallow groundwater recharged from paddy fields and floodplain areas with reducing conditions, evaporation signature of water stable isotopes, and lower nitrate concentration. Nutrient flux estimates for the catchment revealed that nitrate in stream water is considerably contributed by groundwater discharge and shallow groundwater in reducing conditions is a significant source of dissolved phosphorus in stream water, which was more pronounced in the rainy season. This study demonstrated that intense agricultural activities in riparian zones strongly affect stream-aquifer interactions and nutrient delivery to the stream, as well as groundwater. These findings can contribute to understanding hydrological and biogeochemical processes of nutrients in agricultural catchments and establishing an effective management of water use and nutrient application.

链接:

5．粮食安全视角下省际耕地生态补偿的标准量化与机制构建

文献源：中国农业大学学报,2021-11-15

摘要：为促进全国耕地利用布局优化,保障粮食安全与生态服务的持续供给,立足粮食安全视角,在厘清省际耕地生态补偿的理论逻辑和补偿标准的测算思路基础上,运用机会成本损失与生态外溢价值法对2019年受偿区粮食安全保障的耕地生态补偿标准进行了量化研究。结果表明:1)研究区有17个省份处于粮食安全保障的耕地生态赤字区（支付区）,14个省份为盈余区（受偿区）,后者在满足自身粮食需求后,平均约有超过30%的耕地承载的粮食产量和生态服务供给了各生态赤字区;2)受偿区的受偿标准总额约为24 673.4亿元,其中最高的3个省份是河南、山东、安徽,最低的3个省份是宁夏、甘肃、新疆。为此,提出要构建包括补偿主体—目标责任—补偿方式—资金来源构成的补偿机制和配套体系,进一步保障生态补偿的长效实施。

链接:

6．顾及耕地占补平衡的多情景土地利用变化模拟

文献源：武汉大学学报(信息科学版),2021-11-15

摘要：耕地占补平衡是我国耕地保护的重要措施之一。在耕地保护政策从传统数量规模为主向数量-质量-生态一体化的发展过程中，较少有研究系统地分析不同占补平衡策略的未来潜在影响作用。本文以山东省招远市为例，构建了顾及耕地占补平衡策略的多情景土地利用变化模拟模型，通过设计基准情景、耕地数量保护、耕地数量-质量保护、耕地数量-生态保护和耕地数量-质量-生态保护5个情景，分析2030年不同耕地保护策略下耕地规模、生产力和生境质量的演化规律。结果表明，耕地占补平衡情景相较于基准情景，耕地数量、粮食产量、生境质量分别平均提升了$7.230×10^{-3}$、$6.232×10^{-3}$、$7.241×10^{-3}$。其中耕地数量-质量-生态保护策略相比基准情景分别提升$7.230×10^{-3}$、$6.344×10^{-3}$、$7.242×10^{-3}$，其粮食产量和生境质量均高于平均水平，更趋向于耕地规模、质量与生态安全多目标的权衡优化。本文为系统性对比评估多种占补平衡策略，优化耕地保护政策提供了技术支持。

链接:

7．洞庭湖区耕地利用碳排放与生态效率时空特征

摘要：洞庭湖区是长江经济带生态文明建设的重要节点，研究洞庭湖区耕地利用碳排放和生态效率时空特征对推进我国生态文明建设、完成"双碳"目标具有重要意义。论文将耕地利用碳排放作为非期望产出纳入到耕地利用生态效率评价体系中，运用SBM-Undesirable模型，基于县级尺度，揭示洞庭湖区耕地利用碳排放和耕地利用生态效率的时空规律。结果表明：2007—2017年洞庭湖区耕地利用碳排放量呈现出"先波动上升再下降，最后趋于平稳"的态势，且在县级空间尺度上呈现出由2007年的中北部集聚分布状态演变为2017年的零散分布状态；2007—2017年洞庭湖区耕地利用生态效率总体有所提高，且趋向于空间均衡发展。

链接:

http://agri.ckcest.cn/file1/M00/03/17/Csgk0WGbPYCAcniAABMebfb7Oac463.pdf

8．基于物联网的棉田智慧灌溉系统的设计

摘要：新疆棉田目前采取人工灌溉,且现有的棉田智慧灌溉系统存在传输距离短、功耗高、网络结构复杂和信号在传输过程中易受干扰等缺点。为此,设计了一款基于物联网的棉田智慧灌溉系统。该系统利用土壤墒情仪监测棉田的土壤信息,通过无线传输技术（LoRa）将采取的信息传输至上位机平台,通过对棉田不同时期灌溉模型的建立,根据实际情况进行科学有效的灌溉。系统硬件部分采用了E19-433M20SC模块,是基于SX1278为核心的无线通信模块,大大提高了系统的稳定性。该系统的研发减少了水资源的浪费,水资源的利用率提高至40%以上,棉田产量也得到了大幅提高。试验结果表明:系统的稳定性符合要求,数据传输精度高,一次通信失败率0.212%、二次通信失败率为0.054%。

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPLaAQ2OcAAlrm69zztA184.pdf

9．畜禽养殖废水处理技术动态与发展趋势

摘要：近年来，畜禽养殖粪污的处理利用已经成为社会各界关注的焦点。本文着重从工程应用的角度，分析了预处理、厌氧处理、沼液利用、沼液自然处理、好氧处理、厌氧-好氧组合处理、深度处理等工艺单元的技术研究与应用现状。

链接:

http://agri.ckcest.cn/file1/M00/03/17/Csgk0WGbPRKAQvmXABLHFb9gk6o751.pdf

10．Earthworms accelerated the degradation of the highly toxic acetochlor S-enantiomer by stimulating soil microbiota in repeatedly treated soils

文献源：ScienceDirect,2021-10-15

摘要：This study investigated the effects of earthworms on the enantioselective degradation of chloroacetamide her?bicide acetochlor with soil microorganisms in repeatedly treated soils. The S-enantiomer degraded more slowly and exerted stronger inhibition on soil microbial functions than the R-enantiomer in single soil system. A syn?ergistic effect was observed between soil microorganisms and earthworms that accelerated the degradation of both the enantiomers, particularly the highly toxic S-enantiomer, which resulted in the preferential degradation of S-enantiomer in soil-earthworm system. Earthworms stimulated five potential indigenous degraders (i.e. Lysobacter, Kaistobacter, Flavobacterium, Arenimonas, and Aquicell), induced two new potential degraders (i.e. Aeromonas and Algoriphagus), and also significantly strengthened the correlations among these seven dominant potential degraders and other microorganisms. Notably, the relative abundances of Flavobacterium and Aero?monas in soil treated with earthworms for S-enantiomer were higher than those for R-enantiomer. Furthermore, earthworms significantly stimulated overall soil microbial activity and improved three microbial metabolic pathways, and xenobiotics biodegradation and metabolism, signal transduction, cell motility, particularly for the S-enantiomer treatment with earthworms, which alleviated the strong inhibition of S-enantiomer on microbial community functions. This study confirmed that earthworms accelerated the degradation of the highly toxic acetochlor S-enantiomer in soil, providing a potential approach in chloroacetamide herbicide-polluted soil remediation.

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPFaACrDZADI7-sLEC4U899.pdf

11．大规模用水节点的灌溉物联网监控系统设计

文献源：排灌机械工程学报,2021-10-08

摘要：针对现有的大部分智能灌溉的农业物联网系统难以满足大范围多布点的实际灌溉监控管理需求的问题,结合现阶段大规模农业灌溉对海量用水节点监控管理的需求,设计基于工业常用的MODBUUS-RTU协议以及TCP协议进行测点数据的查询和检测站点的管理系统,测点传感器可采用任何满足协议要求的流量传感器;设计IOT服务器和WEB服务器2个服务进程,IOT服务器负责从电磁流量计中查询获取数据并上传至数据库,解决协议识别解析和高并发问题,提高系统处理大量监控节点的能力;WEB服务器从数据库查询

相应的数据信息并进行权限管理,方便系统规模扩展;为了便于系统管理,设计开发具有测点数据查询以及设备管理等功能的配套微信小程序。设计的灌溉物联网系统在实现基本灌溉监控的基础上,综合考虑大规模节点部署、海量数据并发、系统权限控制等现实性问题,为实现节水灌溉提供了切实可行的解决方案。

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPNiAPIoeADZquJXKF5c693.pdf

【会议论文】

1．Towards Sustainable Food Security: An?

Interdisciplinary Approach

发布源：IEEE

发布时间：2021-11-18

摘要：As urbanization moves towards globalization in the next century, the evolution of smart city technologies has also brought new approaches to traditional public wellbeing problems such as food accessibility at both global and local scales. Technology implemented using the Internet of Things and data analytics offers unique advantages and challenges to address issues related to food access. In addition, interdisciplinary efforts are necessary to effectively utilize emerging technologies to address the issue of food insecurity while considering the underlying complex social, economic, and environmental dimensions. In this paper, we discuss the multi-dimensional nature of the food accessibility problem in U.S. metropolitan regions and explore the connection between the fields of engineering, social science, agriculture, education, and life sciences, with respect to their collective impact on addressing the food accessibility problem. We also present our team's ongoing efforts to identify and address food insecurity problems in Richmond, Virginia through interdisciplinary research.

链接:

http://agri.ckcest.cn/file1/M00/03/17/Csgk0WGbPb-ATUBMABMkJC9Obz4298.pdf

2．Smart Farming and Image Analysis of Agriculture Through Deep Learning Resulting in Land Quality Check

发布源：IEEE

发布时间：2021-11-15

摘要：Machine Learning is the ability provided to machines to improve with experience. In

the world, which is preparing itself to get adapted to automated tools in the upcoming future, machine learning defines the core of these dynamic fields such as robotics, various E platforms, etc. & with the extent in vision it has a wider scope. History provides us with the traces that our ancestors discovered the concept of civilization due to agriculture. In the modern world blending the trending automated tools with traditional agricultural practices. India is the largest producer of grains in the world. Being from the land of farmers and farmlands we come across a wide variety of crops that are grown in respective seasons. But sometimes the blessing turns out to be a curse for the farmers. There is a wide variety of challenges farmers face such as climatic disasters, pests, quality of seeds, land quality, etc. and here we are working on using the modern machinery methods to solve these issues and paving the nation towards Jai Jawaan, Jai Kissan, Jai Vigyan. In this present research work, we investigate the Deep learning technology in encompassing traditional farming into Smart farming.

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPWOAOA29AAhCOLLLir4053.pdf

3．Smart Irrigation and Security System for Agricultural Crops and Trees

发布源：IEEE

发布时间：2021-11-15

摘要：The present work in particular, relates to a smart water-irrigation and security system that predicts the quality and fertility of the soil and also gives protection of agricultural seeds during the sowing period. Small sirens will be inserted into the field which help to keep the birds away from the agricultural fields. An additional section of fertilizer will be introduced in the tanker of the system, which will add the required fertilizer accordingly. The system will consist of separate sections which can carry different fertilizers, which will be mixed with the water tanker is used for the irrigation supply. The requirement of different fertilizer will be based on location (GPS) and user input via the internet. A smart centralized system of water piping with several openings will be introduced in the agricultural fields through which water will be automatically supplied in the fields. For the seed-sowing purpose, a smart seed roller has been designed, which will sow the seeds into the ground automatically. The system will be having a solar panel on the top of the equipment, which will continuously charge the internal battery and can be utilized accordingly.The proposed system also provides security from animals, birds and thieves. The

agricultural fields will be shielded with the transparent solar panels, which will allow the sunlight to pass into the fields and will also prevent excess rain which usually destroys the crops. The excess rainwater will be stored into the underground tub, which can also be utilized for irrigation.

链接:

http://agri.ckcest.cn/file1/M00/03/17/Csgk0WGbPaWATtIPABdpHD_cGTg221.pdf

4．Smart Irrigation System using Internet of Things (IoT) and Machine Learning

发布源：IEEE

发布时间：2021-11-15

摘要：Despite the world being in 21st century most of the developing and under-developed nation use traditional method for farming we requires tremendous energy and hectic schedule from a small scale farmer with a very measly return in terms of profit moreover the water wastage and continuous monitoring required to keep check in plants condition is just unjustified but with 58% of population having agriculture as primary income source most of the Indian farmers having extremely low income it seems impossible for them to hop over costly machineries. But now with the cost-effective processors out there in the market can provide a solution to all these issues faced by Indian farmers. With exponential progress of Internet of Things (IoT) devices in the market smart irrigation systems are becoming a new trend. This paper proposes design and theory of one such smart irrigation system using NodeMCU to wirelessly operate a network of irrigation modules by irrigating the field when required by measuring the water content of soil and keep checking condition of plant using a camera this paper also provide insight of how to keep safe integrity of data which travels from NodeMCU to user smartphone using ciphering methods and by keeping proposed system reliable and cost effective.

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPUSADqrDAAtLKLSa9bA200.pdf

<div align="center">【相关专利】</div>

1．一种土地利用率高的大垮度温室大棚及节能种植方法

发布源：中国专利

发布时间：2021-10-26

摘要：本发明公开了一种土地利用率高的大垮度温室大棚及节能种植方法,涉及种植技

术领域,所述大垮度温室大棚包括大棚本体,大棚本体间包括多个平行设置的弧形钢管骨架,弧形钢管骨架中部为固定大棚用的连接钢管,大棚本体两侧设置有与其平行的排水槽,大棚本体还包括有果蔬种植区以及畜牧养殖区,设置多组相互垂直的第一种植垄以及第二种植垄,可以有效对大棚本体内的土地空间进行利用,各垄体之间与排水槽连通,便于将多余水分及时排出,在果蔬种植区一侧设置畜牧养殖区,粪便收集池对畜牧养殖区内牲畜排出的粪便进行收集,相较于传统大棚种植,本发明种植设备土地利用率更高,且更加节能环保,可持续发展利用率高。

链接:

http://agri.ckcest.cn/file1/M00/03/17/Csgk0WGbPheAbC2DAAt8NezPido823.pdf

2．一种蔬菜种植土壤环境自适应浇灌装置及其实施方法

发布源：中国专利

发布时间：2021-10-26

摘要：本发明公开了一种蔬菜种植土壤环境自适应浇灌装置及其实施方法,其中自适应浇灌装置包括支撑柱、主动浇灌组件和水箱,主动浇灌组件和水箱均安装在支撑柱的顶端,主动浇灌组件包括套筒、第一滚轮圈、第二滚轮圈、浇灌架、横置环、齿轮环、主动齿轮、电机和补水过渡件,装置使用时,套筒及其顶端的补水过渡件和浇灌架随之移动,补水过渡件中的三角块会规律性的顶升主动放水组件,在挡水圆板上升时,灌溉用水就会从竖置圆管流下,灌溉用水流到临时储水环道内,灌溉用水再从临时储水环道流到浇灌架,倾斜设置的浇灌架有更好的浇灌效果,同时自适应浇灌装置使用过程简单方便,通过控制电机的转速即可控制规定时间内的浇灌水量,实用性好。

链接:

http://agri.ckcest.cn/file1/M00/0F/E9/Csgk0GGbPb2Ac8KTAAuZs3wKOAs572.pdf

3．一种用于生物农业的多功能水旱混合水稻提升产量种植方法

发布源：中国专利

发布时间：2021-10-26

摘要：本发明公开了一种用于生物农业的多功能水旱混合水稻提升产量种植方法,涉及水稻种植领域。该用于生物农业的多功能水旱混合水稻提升产量种植方法,包括造田平整、造坡开垦、培肥建棚、育苗移栽、灌溉防害、除草养护和收割七个步骤。该用于生物农业的多功能水旱混合水稻提升产量种植方法,能够在雨季起到排涝的作用,减轻过量水分对旱稻生长造成的伤害,降低旱稻涝死的可能性,同时也能将雨水排至水稻田内,积蓄水稻生长过程中需要的水分,降低水稻培育过程中灌溉的成本,同时水稻田也能补充旱

稻田中旱稻生长过程中所需的水分,改善外部地理气候环境对水旱混合稻生长造成的限制,拓宽了水旱混合稻培育的范围和场景。

链接:

http://agri.ckcest.cn/file1/M00/03/17/Csgk0WGbPf6AZCXMAAa0Nx7BMDs634.pdf