《中国农业发展战略研究》专题快报

2018年第11期（总第11期）

【动态资讯】

1．The future of farming: robots, bees and plant jacuzzis

【**AgroNews**】Food production needs to increase by 70 per cent to feed the nine billion population projected for 2050. Fortunately, the industry is benefiting from some radical thinking. Here are the cutting edge technologies taking farming towards this goal. Bees as micro-distributors of pesticide. Bee Vectoring Technologies is a Canadian startup which has developed a commercial alternative to spraying food crops with pesticide. This innovative new method uses bumblebees to distribute a naturally occurring, organic, inoculating fungus while carrying out their natural foraging cycle. The BVT system makes commercially reared bumblebees through a specialist tray dispenser as they leave their hive. They brush past a powder which clings to their fur. The powder is a naturally occurring fungus named clonostachys rosea which, when absorbed by a plant, enables it to effectively block destructive diseases, such as botrytis, in strawberries. The process has many merits. It reduces or negates the need for spraying pesticides, thus preventing chemicals entering the water supply. In a large-scale trial in Florida it delivered comparable or improved disease protection over sprayed chemicals, as well as increasing fruit yield by between 7 and 29 per cent. This fruit was independently shown to be sweeter and had a longer shelf life. In a recent trial on blueberries in Nova Scotia, yield increases were recorded at 77 percent. And the bees, of course, are entirely unharmed.

链接:
http://news.agropages.com/News/NewsDetail---27798.htm

2．Restoring degraded land highlights opportunities for sustainable development in Africa

【**United Nations Environment Programme**】Almost 1,000 participants joined the Global

Landscape Forum's GLF Nairobi 2018 at United Nations Office in Nairobi to hear speakers from across Africa discuss their experiences and successes restoring forests, farms and coastlines. A global audience participated online and the event was a top-trending social media site in Kenya. Community leaders, including Serge Zoubga and Concepta Mukasa discussed their efforts to restore local landscapes, while Rwandan Minister of Lands and Forestry Francine Tumushine, UN Environment Executive Director Erik Solheim, Stefan Schmitz of the German Federal Ministry for Economic Cooperation and Development and the Center for International Forestry Research (CIFOR) Director General Robert Nasi shared insights into the role of restoration in sustainable development and climate mitigation and adaptation."Unless urgent and concerted action is taken, land degradation will worsen in the face of population growth, unprecedented consumption, an increasingly globalized economy and climate change," said CIFOR's Nasi. "We must restore at least 12 million hectares annually simply to reach land degradation neutrality. And if we want to rectify errors from the past, then we need to run twice as fast."

链接**:**

https://www.unenvironment.org/news-and-stories/press-release/restoring-degraded-land-highlights-opportunities-sustainable

3．Policy-makers cannot afford to ignore soil sustainability

【**EurekAlert!**】In a new report, "Opportunities for soil sustainability in Europe", the European Academies' Science Advisory Council (EASAC), which represents the national science academies of the EU, Norway, and Switzerland, says its latest synthesis reveals that policy-makers need to grasp opportunities to safeguard Europe's soils and ensure their sustainability. Back in 2014, insufficient support among Member States obliged the European Commission to withdraw proposals for a Soils Directive and Europe still lacks appropriate benchmarks for soils' sustainability and needs to improve compatibility between different national monitoring systems. In recent comments, Elisabeth Köstinger from the Austrian Presidency of the EU discussed the importance of protecting soils; however, concerted action from Member States remains to be seen. EASAC launched the report today (26 September) at an event with policy-makers and stakeholders at the Palace of the Academies in Brussels.

链接**:**

https://www.eurekalert.org/pub_releases/2018-09/easa-pca092518.php

4．Illinois research accurately predicts US end-of-season corn yield

【**EurekAlert!**】URBANA, Ill. - Crop yield predictions are a key driver of regional economy and financial markets, impacting nearly the entire agricultural supply chain. That's why economists, agricultural researchers, government agencies, and private companies are working to improve the accuracy of these predictions. "Using seasonal forecasts and satellite data, we developed a very advanced yield prediction system for both the national and county levels. Our research demonstrates that we can do better than the USDA's real-time estimation," says Kaiyu Guan, principal investigator on the Geophysical Research Letters study, and assistant professor in the Department of Natural Resources and Environmental Sciences (NRES) at U of I and Blue Waters professor at the National Center for Supercomputing Applications (NCSA).

链接:

https://www.eurekalert.org/pub_releases/2018-09/uoic-ira092718.php

5．High yield modern farming better for the environment, says Nature study

【**AgroNews**】A new study in Nature Sustainability reports that "Extensive field data suggest that impacts on wild populations would be greatly reduced through boosting yields on existing farmland so as to spare remaining wild habitats." Basically, producing more food on less land is really good for the environment because farmers will plow up fewer forests and prairies, thus leaving more land for nature. To come to this conclusion, the team of researchers associated with Cambridge University analyzed the effects on the natural environment of Asian paddy rice, European wheat cultivation, Latin American beef, and European dairy production. They measured the impacts of these four agricultural sectors on greenhouse gas emissions, water use, nitrogen and phosphorus fertilization, and soil losses. Among other intriguing results, the study found that, for the same amount of milk, organic systems caused at least one third more soil loss and took up twice as much land as conventional dairy farming. "Organic systems are often considered to be far more environmentally friendly than conventional farming, but our work suggested the opposite," said study co-author Dr. David Edwards in the Cambridge press release on the study. "By using more land to produce the same yield, organic may ultimately accrue larger environmental costs."

链接:

http://news.agropages.com/News/NewsDetail---27761.htm

6．全球14大农业研究前沿出炉！中国居主导地位

【凤凰网科技】科技日报北京9月20日电 （记者瞿剑）20日在京开幕的2018中国农业农村科技发展高峰论坛对外发布《中国农业农村科技发展报告（2012-2017）》及《2017全球农业研究前沿分析解读》等4个子报告。其中《2017全球农业研究前沿分析解读》出炉了当今全球14个农业研究前沿，中国与美、英、德、澳等国一起，居于这14个农业研究前沿的主导地位。14个农业研究前沿包括，植物基因组编辑技术研究及其在作物育种中的应用、全基因组选择技术在作物育种中的应用、全球作物模型改进及其与经济模型耦合、十字花科作物功能基因组学与分子设计育种、碳3植物的碳4合成途径及高光效育种、作物根系研究技术及根系构型的优化设计、植物与丛枝菌根真菌的共生机制与功能研究、基于生态系统水平的渔业资源评估与管理、海洋酸化和暖化对海洋动物行为的影响、蜜蜂健康与农业生态安全、高光谱成像与传感器技术在农产品质量安全检测中的应用、生物柴油的制备及其在农用动力机械中的应用、生物炼制过程中木质纤维素生物质资源的降解转化研究、致瘿昆虫对寄主植物的调控机制。

链接:

http://tech.ifeng.com/a/20180922/45178405_0.shtml

7．提升耕地质量 夯实农业生产能力

【中国农业网】近日，农业农村部答复并公开了"关于提升耕地质量夯实农业生产能力的建议 "。一是关于构建耕地质量保护的法律保障。为切实加强耕地质量管理，农业农村部积极推进耕地质量保护立法。包括：开展耕地质量保护立法调研；推动地方开展耕地质量保护立法；加强耕地质量保护监督考核；完善农用地土壤环境标准体系。二是关于加大耕地质量建设支持力度。农业农村部加强与财政部等部门的沟通，积极争取财政资金，加强耕地质量保护与提升。包括：加强耕地地力保护；加强农田基础设施建设；促进耕地质量提升；加强土壤污染治理修复；健全投入机制。三是关于倡导农业可持续发展模式。农业农村部坚决贯彻中央的决策部署，落实最严格的耕地保护制度，加快实施"藏粮于地、藏粮于技"战略，下大力气，强化措施，开展耕地土壤改良、地力培肥和治理修复。包括：开展耕地质量保护与提升行动；开展东北黑土地保护利用试点；开展南方重金属污染综合治理；开展耕地轮作休耕制度试点；广泛开展耕地与土壤保护主题宣传。

链接:
http://www.agronet.com.cn/Tech/1248378.html

8．打响农业面源污染防治攻坚战 昆明力争2020年化肥农药施用量实现负增长

【云南网】中秋时节，金黄的稻谷迎来丰收，谷下鲫鱼、泥鳅以稻花和浮游生物为食，

个大肥美，稻花香引来蝴蝶环绕，田间环境优美；安宁八街街道八街村委会月照屯村的昆明市优质玫瑰示范基地，示范推广异色瓢虫防治食用玫瑰蚜虫，减少化学农药施用……在提质增产增收背后，绿色生态种植技术的推广，也在改变着昆明传统的农业生产方式。日前，昆明市打响一场农业面源污染治理战役，力争2020年化肥农药施用量实现负增长。响应号召——打响农业面源污染防治攻坚战；农药减量——生物防治取代化学农药；化肥增效——科技助力测土施肥。

链接：

http://yn.yunnan.cn/system/2018/09/24/030077825.shtml

9．"千万工程"获大奖是对中国建设绿色家园的高度认可

【新华网】中国浙江省"千村示范、万村整治"工程（以下简称"千万工程"）26日荣获联合国环境保护最高荣誉——"地球卫士奖"。前来领奖的浙江省环境保护厅厅长方敏接受新华社记者专访时表示，这次获奖体现了联合国环境规划署对中国建设绿色家园努力的高度认可。方敏说，本世纪初，浙江省工业化、城市化发展较快，与快速推进的城市建设和日新月异的城市面貌相比，农村建设和社会发展明显滞后，特别是农村人居环境堪忧。农村的面源污染一度占到水污染总量的50％以上，与城市点源污染治理相比治理难度更大。这既制约了环境改善，更影响了人们的生活质量。她介绍，畜禽养殖、化肥农药、生活垃圾污染是农村环境污染的主要因素。"百姓钱是多的，周边水是黑的""家里现代化，屋外脏乱差"是当时村里人常发的抱怨。在这一背景下，2003年浙江启动了"千万工程"。方敏说，15年来，浙江省把"千万工程"作为推动农村全面小康建设的基础工程、统筹城乡发展的龙头工程、优化农村环境的生态工程、造福农民群众的民心工程。在"千万工程"的实践中，浙江从环境整治入手，把治污水、治垃圾、改造厕所作为突破口，还加强了"散乱污"企业治理，安排分散小企业进入工业园区转型升级。一系列措施得到了百姓的拥护与积极参与。

链接：

http://www.xinhuanet.com/world/2018-09/27/c_1123493511.htm

10．中共中央　国务院印发《乡村振兴战略规划（2018－2022年）》

【中华人民共和国农业农村部】党的十九大提出实施乡村振兴战略，是以习近平同志为核心的党中央着眼党和国家事业全局，深刻把握现代化建设规律和城乡关系变化特征，顺应亿万农民对美好生活的向往，对"三农"工作作出的重大决策部署，是决胜全面建成小康社会、全面建设社会主义现代化国家的重大历史任务，是新时代做好"三农"工作的总抓手。从党的十九大到二十大，是"两个一百年"奋斗目标的历史交汇期，既要全面建

成小康社会、实现第一个百年奋斗目标，又要乘势而上开启全面建设社会主义现代化国家新征程，向第二个百年奋斗目标进军。为贯彻落实党的十九大、中央经济工作会议、中央农村工作会议精神和政府工作报告要求，描绘好战略蓝图，强化规划引领，科学有序推动乡村产业、人才、文化、生态和组织振兴，根据《中共中央、国务院关于实施乡村振兴战略的意见》，特编制《乡村振兴战略规划（2018－2022年）》。本规划以习近平总书记关于"三农"工作的重要论述为指导，按照产业兴旺、生态宜居、乡风文明、治理有效、生活富裕的总要求，对实施乡村振兴战略作出阶段性谋划，分别明确至2020年全面建成小康社会和2022年召开党的二十大时的目标任务,细化实化工作重点和政策措施，部署重大工程、重大计划、重大行动，确保乡村振兴战略落实落地，是指导各地区各部门分类有序推进乡村振兴的重要依据。

链接:

http://www.moa.gov.cn/xw/zwdt/201809/t20180926_6159028.htm

【行业报告】

1．Agriculture in the United Kingdom 2017

发布源：GOV.UK

发布时间：2018-05-31

摘要：This annual publication provides an overview of agriculture in the UK. It contains an extensive range of data including farm incomes, land use, livestock numbers, prices, production of key commodities (e.g. wheat, milk, vegetables), overseas trade, organic farming and the environment. The information is used widely by government, industry, researchers and other stakeholders to support policy monitoring and development.

链接:

http://agri.ckcest.cn/ass/2d408298-4892-498d-890f-46462caaad53.pdf

【文献速递】

1．Agriculture is a major source of NO_x pollution in California

作者：Maya Almaraz; Edith Bai; Chao Wang, et al.

文献源：Science Advances,2018

摘要：Nitrogen oxides (NO_x = NO + NO_2) are a primary component of air pollution—a leading cause of premature death in humans and biodiversity declines worldwide. Although regulatory policies in California have successfully limited transportation sources of NO_x pollution, several of the United States' worstair quality districts remain in rural regions of the state. Site-based findings suggest that NO_x emissions from California's agricultural soils

could contribute to air quality issues; however, a statewide estimate is hitherto lacking. We show that agricultural soils are a dominant source of NO_x pollution in California, with especially high soil NO_x emissions from the state's Central Valley region. We base our conclusion on two independent approaches: (i) a bottom-up spatial model of soil NO_x emissions and (ii) top-down airborne observations of atmospheric NO_x concentrations over the San Joaquin Valley. These approaches point to a large, overlooked NO_x source from cropland soil, which is estimated to increase the NO_x budget by 20 to 51%. These estimates are consistent with previous studies of point-scale measurements of NO_x emissions from the soil. Our results highlight opportunities to limit NO_x emissions from agriculture by investing in management practices that will bring co-benefits to the economy, ecosystems, and human health in rural areas of California.

链接:
http://agri.ckcest.cn/ass/c1f53332-e35f-46b5-8c0e-35d8fa850201.pdf

2．The potential of agricultural land management to contribute to lower global surface temperatures

作者：Allegra Mayer; Zeke Hausfather; Andrew D. Jones, et al.

文献源：Science Advances,2018

摘要：Removal of atmospheric carbon dioxide (CO_2) combined with emission reduction is necessary to keep climate warming below the internationally agreed upon 2℃ target. Soil organic carbon sequestration through agricultural management has been proposed as a means to lower atmospheric CO_2 concentration, but the magnitude needed to meaningfully lower temperature is unknown. We show that sequestration of 0.68 Pg C $year^{-1}$ for 85 years could lower global temperature by 0.1℃ in 2100 when combined with a low emission trajectory [Representative Concentration Pathway (RCP) 2.6]. This value is potentially achievable using existing agricultural management approaches, without decreasing land area for food production. Existing agricultural mitigation approaches could lower global temperature by up to 0.26℃ under RCP 2.6 or as much as 25% of remaining warming to 2℃. This declines to 0.14℃ under RCP 8.5. Results were sensitive to assumptions regarding the duration of carbon sequestration rates, which is poorly constrained by data. Results provide a framework for the potential role of agricultural soil organic carbon sequestration in climate change mitigation.

链接:
http://agri.ckcest.cn/ass/c1cb0f0f-b8a6-4d11-b7f2-ab063be282ea.pdf

3. Evolution of China's water footprint and virtual water trade: A global trade assessment?

作者：Xu Tian; Joseph Sarkis; Yong Geng, et al.

文献源：Environment International,2018

摘要：Water embodied in traded commodities is important for water sustainability management. This study provides insight into China's water footprint and virtual water trade using three specific water named Green, Blue and Grey. A multi-region input-output analysis at national and sectoral analysis levels from the years 1995 to 2009 is conducted. The evolution and position of China's virtual water trade across a global supply chain are explored through cluster analysis. The results show that China represented 11.2% of the global water footprint in 1995 and 13.6% in 2009. The green virtual water is the largest of China's exports and imports. In general, China is a net exporter of virtual water during this time period. China mainly imports virtual water from the USA, India and Brazil, and mainly exports virtual water to the USA, Japan and Germany. The agriculture sector and the food sector represent the sectors with both the largest import and export virtual water quantities. China's global virtual water trade network has been relatively stable from 1995 to 2009. China has especially close relationships with the USA, Indonesia, India, Canada, Mexico, Brazil and Australia. Trade relations, resource endowment and supply-demand relationships may play key roles in China's global virtual water footprint network rather than geographical location. Finally, policy implications are proposed for China's long term sustainable water management and for global supply chain management in general.

链接**:**

http://agri.ckcest.cn/ass/093f849a-4359-44da-a402-82dcbd41ccf2.pdf

4．Uncovering resource losses and gains in China's foreign trade

作者：Xu Tian; Yong Geng; Elvira Buonocore, et al.

文献源：Journal of Cleaner Production,2018

摘要：Natural resource storages and flows play an important role in economic and social processes. In this paper we explore the trade of primary commodities between China and its main trade partners during the years 2000 and 2008. Emergy accounting is used to assess the environmental support associated with the resources exchanged. Mass, emergy and financial capital export-to-import ratios confirm that economy-level trade advantages should not just rely on capital flow. A holistic evaluation of the trade process, including resource environmental value should be performed to identify trade balance and stability. Results show that while China's imports monetary value is much larger than exports

monetary value, China receives more emergy (environmental support) in trade than it gives; benefiting from the ability of primary resources to drive its economy. Developed economies, characterized by a low Emergy-to-Money-Ratio, gain more from trade of primary commodities with China. Developing and underdeveloped economies, with higher Emergy-to-Money-Ratio, lose in the environmental support balance to China, indicating the existence of a potentially unsustainable trade imbalance.

链接:

http://agri.ckcest.cn/ass/2e9908d1-467c-445f-b87b-63541046d435.pdf

5．Exploring the role of land degradation on agricultural land use change dynamics

作者：S. Bajocco; D. Smiraglia; M. Scaglione, et al.

文献源：Science of the Total Environment,2018

摘要：The role that land-use and socioeconomic factors exert on consolidating land degradation (LD) processes is a major research issue. However, intensity and type of the impact played by LD on such land use factors is still underexplored. The present study investigates the role of LD on land-use change (LUC) trajectories of land abandonment (LA) and urban expansion (URB) in the three geographical repartitions (North, Centre, South) of Italy between 1990 and 2012, by means of the Environmental Niche Factor Analysis (ENFA). ENFA is a multivariate approach originally introduced in the analysis of animal ecology allowing to compute habitat suitability (HS) models without requiring presence/absence data. Four environmental quality indices about climate (CQI), soil (SQI), vegetation (VQI) and land management (MQI) have been analyzed for the years 1990 and 2000 and related to the trajectories of LA and URB, respectively, for the time periods 1990—2000 and 2000—2012. Empirical results have indicated that different driving forces are linked to LA and URB, and that for each trajectory, the role of some forces may change over time. Evidence shows that soil quality and low human pressure represent the main drivers of LA. By contrast, as for URB, high human pressure represented the main driving factor throughout the country, both during 1990—2000 and 2000—2012. The HS maps show the probability arrangement of LA and URB in the three geographical repartitions. Starting from this work, further research is increasingly required to implement prediction models of future LA and URB trajectories according to the current land quality status.

链接:

http://agri.ckcest.cn/ass/11e867c8-b0d6-43dc-87d8-dcbb1011344c.pdf

6．Global arable land transfers embodied in Mainland China's foreign trade

作者：Mengyao Han; Guoqian Chen

文献源：Land Use Policy,2018

摘要：The process of globalization increases spatial separation of basic resources in terms of demand and supply across multiple countries/regions, thereby leading to the shift of environmental pressure mainly triggered by population expansion and economic growth via global supply chains. To comprehensively analyze Mainland China's arable land use issues, the present work illustrates its arable land transfers embodied in foreign trade based on a multi-regional input-output analysis. In total, the trade volume of Mainland China's arable land transfers is revealed in magnitude up to 70% of its direct arable land area. With a distinction between production- and consumption-based transfers, Mainland China exports 27.18 Mha (million hectares) of embodied arable land to other economies, while it imports 48.35 Mha of embodied arable land, making it a large force for agricultural industry development and arable land utilization in regions such as ASEAN, EU27, and Africa. The relations, pressures, and structures of embodied arable land related to Mainland China are clearly depicted from the global perspective. With detailed embodied arable land transfer profiles, it is practical to comprehensively analyze Mainland China's arable land utilization via supply chains from the global perspective for essential policy implications in reasonably reshaping Mainland China's economic structures and trade patterns.

链接**:**

http://agri.ckcest.cn/ass/68ba39ce-67bd-409c-a05e-b710d09e7029.pdf

7．Future soil moisture and temperature extremes imply expanding suitability for rainfed agriculture in temperate drylands

作者：John B. Bradford; Daniel R. Schlaepfer;   William K. Lauenroth, et al.

文献源：Scientific Reports,2018

摘要：The distribution of rainfed agriculture, which accounts for approximately ¾ of global croplands, is expected to respond to climate change and human population growth and these responses may be especially pronounced in water limited areas. Because the environmental conditions that support rainfed agriculture are determined by climate, weather, and soil conditions that afect overall and transient water availability, predicting this response has proven difficult, especially in temperate regions that support much of the world's agriculture. Here, we show that suitability to support rainfed agriculture in

temperate dryland climates can be efectively represented by just two daily environmental variables: moist soils with warm conditions increase suitability while extreme high temperatures decrease suitability. 21st century projections based on daily ecohydrological modeling of downscaled climate forecasts indicate overall increases in the area suitable for rainfed agriculture in temperate dryland regions, especially at high latitudes. The regional exception to this trend was Europe, where suitability in temperate dryland portions will decline substantially. These results clarify how rising temperatures interact with other key drivers of moisture availability to determine the sustainability of rainfed agriculture and help policymakers, resource managers, and the agriculture industry anticipate shifts in areas suitable for rainfed cultivation.

链接:

http://agri.ckcest.cn/ass/40f0bba4-7a61-4bd6-b44a-041e70ab1ee6.pdf

8．Progress towards sustainable intensification in China challenged by land-use change

作者：Lijun Zuo; Zengxiang Zhang; Kimberly M. Carlson, et al.

文献源：Nature Sustainability,2018

摘要：China is experiencing rapid land-use change and shifts in farm management. However, the interactive effects of these drivers on cropping system sustainability are unclear. Here, we evaluate spatio-temporal trade-offs among crop production and five key environmental indicators, including land use, water consumption, excess nitrogen and phosphorous use, and greenhouse gas emissions in China. From 1987 to 2010, as crop kilocalorie production increased (+66%), so did the total environmental impact of all indicators (+1.3161%) except greenhouse gas emissions (−18%). Concurrently, environmental intensity—impact per kilocalorie produced—decreased for all indicators (−51–13%) except excess phosphorus (+57%). Despite substantial loss and displacement of cropland to urban expansion, counterfactual scenario analysis indicates that farm management explained >90% of changes in crop production and environmental impact. However, cropland is expanding in regions of relatively high land and irrigation intensity. Although efficiency gains partly compensated for increased environmental pressures, continued geographic shifts in cropland could challenge progress towards agricultural sustainability in China.

链接:

http://agri.ckcest.cn/ass/5e3ac89c-de30-4c1f-be9e-6a68296b7269.pdf

9．An assessment of the global impact of 21st century land use change on soil erosion

作者：Pasquale Borrelli; David A. Robinson; Larissa R. Fleischer, et al.

文献源：Nature Communications,2018

摘要：Human activity and related land use change are the primary cause of accelerated soil erosion, which has substantial implications for nutrient and carbon cycling, land productivity and in turn, worldwide socio-economic conditions. Here we present an unprecedentedly high resolution (250 × 250 m) global potential soil erosion model, using a combination of remote sensing, GIS modeling and census data. We challenge the previous annual soil erosion reference values as our estimate, of 35.9 Pg yr^{-1} of soil eroded in 2012, is at least two times lower. Moreover, we estimate the spatial and temporal effects of land use change between 2001 and 2012 and the potential offset of the global application of conservation practices. Our findings indicate a potential overall increase in global soil erosion driven by cropland expansion. The greatest increases are predicted to occur in Sub-Saharan Africa, South America and Southeast Asia. The least developed economies have been found to experience the highest estimates of soil erosion rates.

链接**:**

http://agri.ckcest.cn/ass/e670904f-c0ee-4287-8870-22004517668a.pdf

10．Alternative cereals can improve water use and nutrient supply in India

作者：Farhad Fathieh; Markus J. Kalmutzki; Eugene A. Kapustin, et al.

文献源：Science Advances,2018

摘要：Humanity faces the grand challenge of feeding a growing, more affluent population in the coming decades while reducing the environmental burden of agriculture. Approaches that integrate food security and environmental goals offer promise for achieving a more sustainable global food system, yet little work has been done to link potential solutions with agricultural policies. Taking the case of cereal production in India, we use a process-based crop water model and government data on food production and nutrient content to assess the implications of various crop shifting scenarios on consumptive water demand and nutrient production. We find that historical growth in wheat production during the rabi (non-monsoon) season has been the main driver of the country's increased consumptive irrigation water demand and that rice is the least water-efficient cereal for the production of key nutrients, especially for iron, zinc, and fiber. By replacing rice areas in each district with the alternative cereal (maize, finger millet, pearl millet, or sorghum) with the lowest

irrigation (blue) water footprint (WFP), we show that it is possible to reduce irrigation water demand by 33% and improve the production of protein (+1%), iron (+27%), and zinc (+13%) with only a modest reduction in calories. Replacing rice areas with the lowest total (rainfall + irrigation) WFP alternative cereal or the cereal with the highest nutritional yield (metric tons of protein per hectare or kilograms of iron per hectare) yielded similar benefits. By adopting a similar multidimensional framework, India and other nations can identify food security solutions that can achieve multiple sustainability goals simultaneously.

链接:

http://agri.ckcest.cn/ass/ec602269-9abb-440e-93c2-745157ec7c51.pdf