Managing Scarce Water Resources in Irrigated Agri-food Systems of Central Asia
中央アジアの灌漑農業システムにおける水資源管理

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Irrigated agriculture is the backbone of Central Asian economies. Therefore, efficient irrigation water management is of crucial importance to the sustainable crop production in the region and building of resilience to water scarcity. Presented here are two studies aiming to improve agricultural water productivity – Evapotranspiration (ET)-based irrigation scheduling in Uzbekistan; and Valuation of ecosystem services in Kazakhstan.

The ET-based irrigation scheduling method has the potential to replace subjective daily water management decisions at Water Users Association level with crop water demand-based decisions to improve water-use efficiency. Results from a two year study showed that there can be a 32-35% saving of water when irrigation is applied using the ET-based scheduling method (Table 1). The pilot plots are representative of 38% of irrigated area in Fergana Valley (241,407 ha) and 50% in Khorezm (137,500 ha) area (Fig. 1). If this methodology is widely adopted by the WUAs of both locations, large amounts of water can be saved which can be diverted for other purposes.

Flood irrigation of cotton is practiced on 128,000 ha in the Bugunski Reservoir watershed of Kazakhstan (Fig. 1). This practice is unsustainable due to seasonal unavailability in water supply and depletion of river discharges that were historically important at maintaining water levels downstream in nearby wetlands and the Aral Sea. Farmer surveys were used along with Resource Investment Optimization System (RIOS) and Soil and Water Assessment Tool (SWAT) modeling to evaluate alternative irrigation practices and cropping systems that can conserve water from the Bugunski Reservoir while maintaining farmer incomes. Simulations showed significant reductions in irrigation water demand in the alternative scenario relative to the baseline scenario. Under baseline flood irrigation of cotton, annual irrigation demand was 928 MCM/yr averaged over the 32 year climatic record simulated. Irrigated demand decreased by 38% to 573 MCM/yr when 40,439 ha of flood irrigated cotton was converted to drip irrigated cotton, sprinkler irrigated alfalfa and drip irrigated grapes. This represents a savings of 355 MCM/yr in water extracted from irrigation canals and groundwater wells. The water conserved would then be available for other downstream uses, including recharge of wetlands and replenishment of the Aral Sea.

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Figure 1 Map showing locations of Khorezm and Fergana Valley in Uzbekistan and Bugunski reservoir in Kazakhstan.

研究対象地の概要（ホレズム地区，フェラガナ盆地，ブグン貯水池）

Table 1 Comparison of yield and water productivity under conventional and evapotranspiration-based irrigation method for cotton and wheat crop in Khorezm and Fergana Valley area in Uzbekistan.

ウズベキスタン・ホレズムおよびフェラガナ盆地における原稿の灌漑方法とリアルタイム蒸発散量に基づく灌漑方法による収量および水生産性の比較

Site (HMZ*)	Water applied (mm)		Yield (kg ha^{-1})		Water productivity (kg $ha^{-1}mm^{-1}$)	
	Conventional irrigation	ET-based irrigation	Conventional irrigation	ET-based irrigation	Conventional irrigation	ET-based irrigation
Khorezm (I)	756	492	5700	5800	0.75	1.17
Fergana (I)	542	359	4011	3985	0.74	1.11
Fergana (II)	631	477	3975	4579	0.63	0.96
Fergana (VIII)	620	407	3968	3500	0.64	0.86

* HMZ I: Sandy loam soil with ≤ 3m groundwater table depth; HMZ II: deep sandy loam and light loam soil with ≤ 3m groundwater table depth; HMZ VIII: light and medium loamy, heavy loamy with light texture in deeper layers, 1-2m groundwater table depth.

＜和文要旨＞

灌漑農業は中央アジア経済の支柱であり，効率の良い灌漑管理は地域の持続的な食料生産や渇水に対するレジリエンスを強化するためにも重要である。本報では，水生産性を高めることを目的として，リアルタイム蒸発散量に基づく灌漑スケジューリングに関するウズベキスタンとカザフスタンでの研究事例を報告する。また，現行の畝間灌漑からスプリンクラー灌漑やドリップ灌漑に替えることによる節水効果の研究事例についても紹介する。