

**Water Management for Appropriate Water Allocation
and
Its Implication of Food Security
- Theoretical Considerations -**

**Kenji YOSHINAGA (Dr.)
The Faculty of Regional Development Studies
Toyo University, Japan**

Definition of Water Scarcity and Efficiency

- **Definition of water scarcity (or shortage)**

(1) Physical scarcity that is defined as shortage of supply to meet demands.

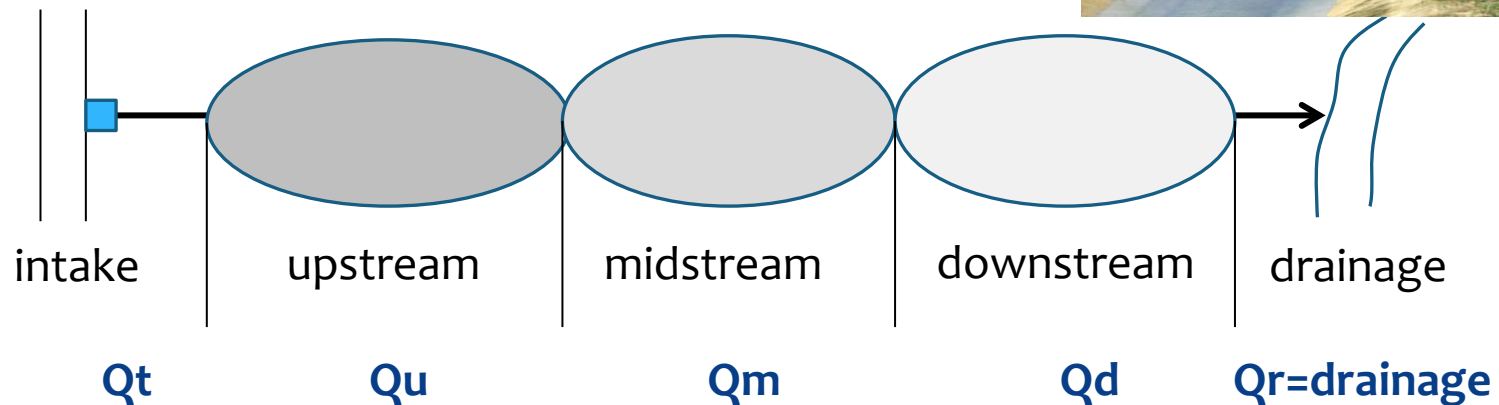
(2) Economic water scarcity that is defined as an ability to meet demand.

(3) institutional water scarcity that could be defined as a failure of institutions .

- The situation of “water scarcity” is defined as the one where these three elements are filled up and still the water is short or scarce.

- Water “efficiency” in the three levels; at the field level, system level and watershed levels.

Water flow from upstream to downstream in irrigation system



- The upstream will save the amount of water $q_u = Q_u - Q_u' > 0$, followed by $q_m = Q_m - Q_m' + q_u > 0$ for the midstream and $q_d = Q_d - Q_d' + q_m > 0$ for the downstream.
- This is a complete case as a results of which all levels of farmers made their efforts to use water efficiently.

A couple of suggestions

- The real situation , however, is far from a reasonable water management: **few suggestions as follows;**

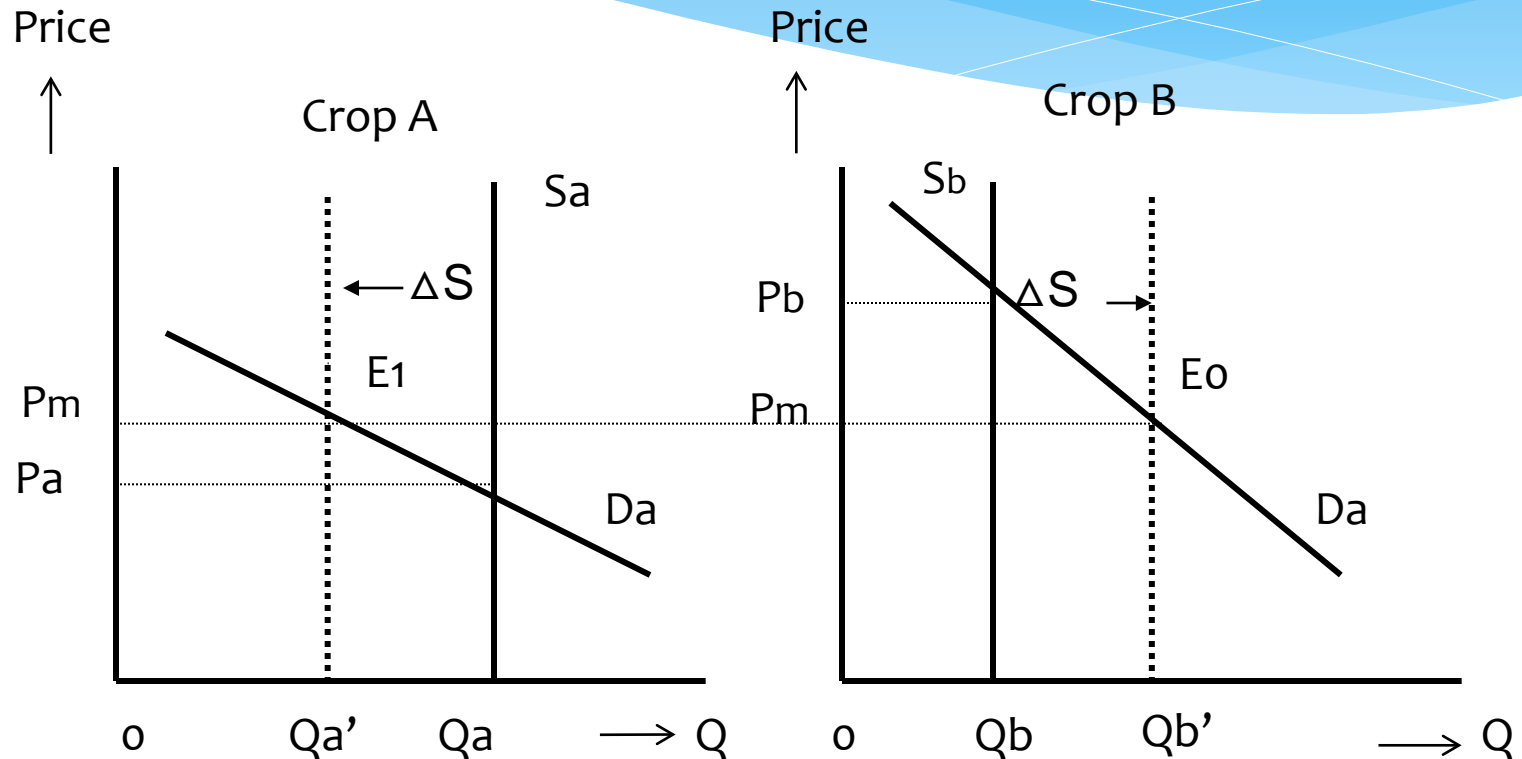
(1) The farmers upstream in particular and midstream → efforts for an efficient water use.

(2) The farmers midstream and downstream → not be a free-rider.

(3) Coordination and cooperation → to eliminate asymmetric information between different levels.

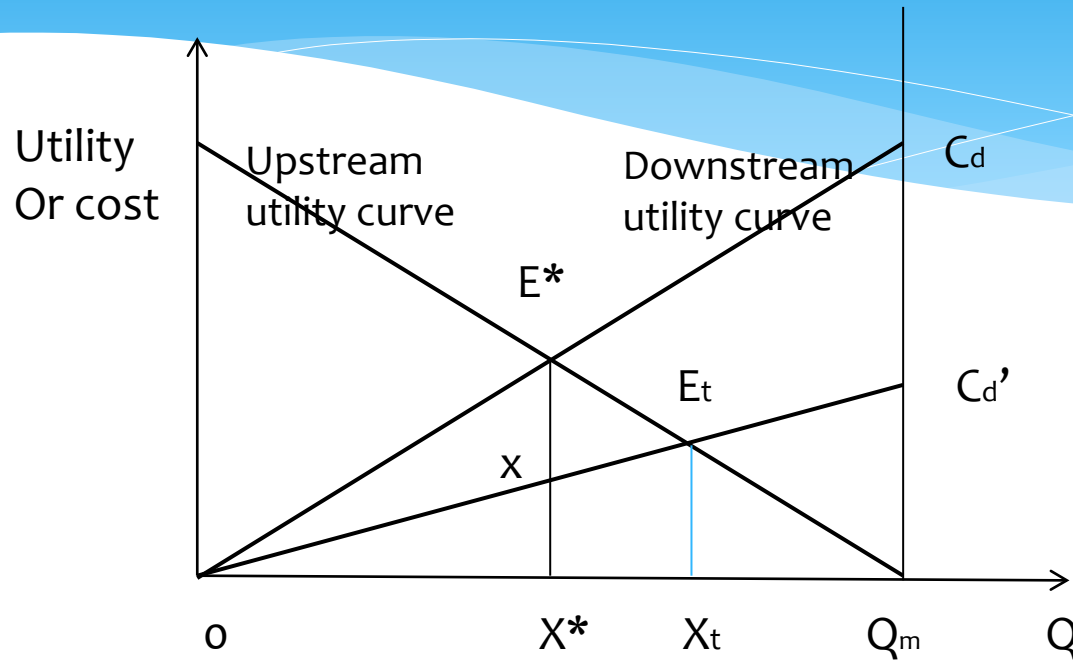
(4) The water management practice → a mutual consensus on keeping rules and obligation.

Water transfer to the highest value water use



- The water transfer from crop A to Crop B improves a social welfare of $0P_mE_oO_{b'} > 0P_mE_1Q_{a'}$

Upstream and downstream conflict



The Coase Theory:

(1) W/O transaction cost: $E^*X^*Q_m C_d > E^*X^*Q_m$

(2) W/ transaction cost: $E^*X^*E_t$ is residual cost reduced by the farmers downstream

Incentives and penalties for a fair water allocation(1)

		downstream	
		effort	No-effort
upstream	effort	(a, a)	(c, b)
	no-effort	(b, c)	(d, d)

(A)

		downstream	
		effort	No-effort
upstream	effort	(a-x, a)	(c, b)
	no-effort	(b, c)	(d, d)

(B)

		downstream	
		effort	No-effort
upstream	effort	(a-x+t, a-t)	(c, b)
	no-effort	(b, c)	(d, d)

(C)

- pay-off: $a > b > c > d$
- Nash equilibrium:
 - (A) → (effort, effort)
 - (B) → (no-effort, effort) : where, $a-x < b$
 - (C) → (effort, effort)
- Nash Equilibrium of (C) will be achieved by payment, t , from downstream to upstream. where, $b-a+x < t < a-b$.

Incentives and penalties for a fair water allocation(2)

		downstream	
		effort	no-effort
upstream	effort	(b, a)	(c, b)
	no-effort	(a, c)	(d, d)

(A)

		downstream	
		effort	no-effort
upstream	effort	(b, a)	(c, b)
	no-effort	(a-p, c)	(d, d)

(B)

- Nash Equilibrium: (A) → (no-effort, effort), (B) → (Effort, Effort)
- Nash Equilibrium is of (B) will be achieved by the imposes penalty of, p to the upstream. Where, $p > a - b$.
- Different types of economic measures such as compensation, transfer, fund raising and penalty → e.g. CO₂ trade emission, payment for environment (or biological) service.
- The economic measures should be integrated in an agreement of the water users association and should be given enforceability as a contract.

Institutional incentives for enhancing activities of water users association

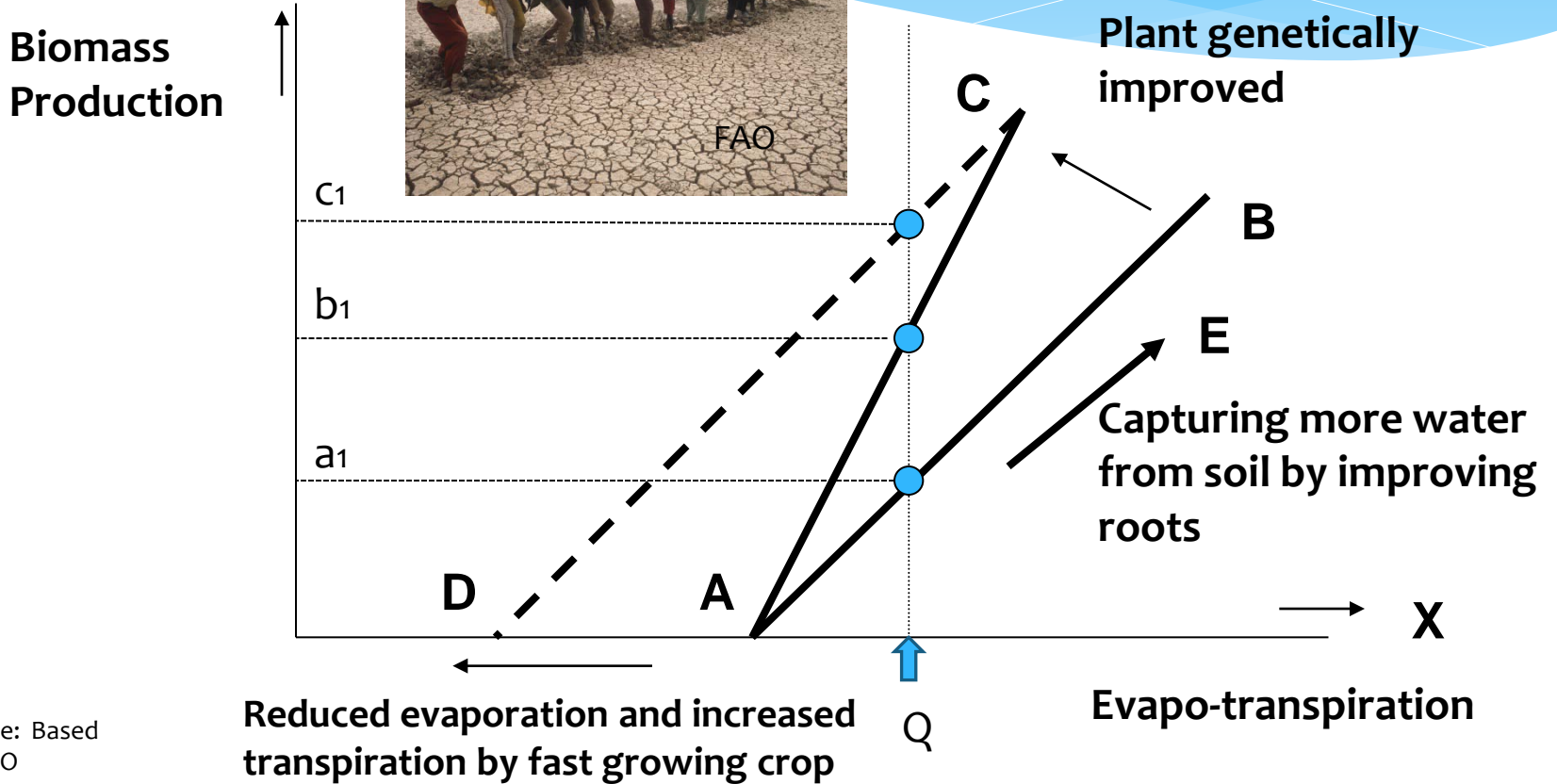
Institutional incentives in case of UPRIIS, Philippines

	Contract	Incentives
Type I	<ul style="list-style-type: none">• clearing of debris• cutting grasses and obstruct• cleaning canals	<ul style="list-style-type: none">• National Irrigation Administration pays 2,400 pesos per month to Irrigator's Association for their activities.
Type II	<ul style="list-style-type: none">• responsibility of service fee collection	<ul style="list-style-type: none">• IA gets commission of 2-15% from NIA if collection rate at least more than 51%.
Type III	<ul style="list-style-type: none">• full management of National Irrigation System	<ul style="list-style-type: none">• IA pays, through annual amortization, the construction or rehabilitation cost.

Source: based on Ofrecio (2005)

- It is a motivation but usually the enforceability is weak and not binding.
- A successful institutional incentive contributes to strengthen a fabric of the community.

A combination of technologies for water productivity (A crop, A Drop)



Source: Based on FAO

Definition and understanding of food security

Process in FAO	Definition of food security
The World Food Conference, 1974	<ul style="list-style-type: none"> • Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices.
The World Conference on Food Security, 1983	<ul style="list-style-type: none"> • Ensuring that all people at all times have both physical and economic access to the basic food that they need.
The World Food Summit, 1996	<ul style="list-style-type: none"> • Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. • Four elements: (a) food availability, (b) food access, (c) Utilization, (d) Stability
World Summit on Food Security, 2009	<ul style="list-style-type: none"> • The World Summit on Food Security unanimously adopted a declaration pledging renewed commitment to eradicate hunger from the face of the earth sustainably and at the earliest date.

Source: FAO

- Changes of definition: supply side → demand side → a balance of supply and demand.

Water management for food security

	Water management	Food security
Field level	<ul style="list-style-type: none"> • Upstream and downstream coordination along the canal • On-farm management • Collective actions • Incentives and penalties 	<ul style="list-style-type: none"> • Amount of yield • Post-harvesting • Gross and net income • Incomes from non-farming sector • Water productivity
System level	<ul style="list-style-type: none"> • Contract and agreement • Activities by WUA • Irrigation fee collection • Equal water distribution • O&M • Rehabilitation of irrigation facilities 	<ul style="list-style-type: none"> • Balance of yields (upstream and downstream) • Biodiversity and ecosystem (by water allocation) • Amount of marketing
National level	<ul style="list-style-type: none"> • Institutional arrangements • Subsidy and advocacy • R&D (e.g. water harvesting) • Investment • Modernization of irrigation system 	<ul style="list-style-type: none"> • Self-sufficiency • Balance between food supply and demand • Import and export • Storage • Downstream food industry
International Level	<ul style="list-style-type: none"> • International agreements (e.g. IWRM) • Investment • Financial and technical assistance • R&D (e.g. climate change)¹² 	<ul style="list-style-type: none"> • Trade regime (e.g. WTO and MEAs) • International commodity prices • Emergency food supply • MDGs achievement

Institutional arrangement and investment in water

Institutional agreement at International level

- It should be integrated into national water related laws and regulations for taking actions as a country basis.
- The **MDGs** of poverty and hunger reduction cannot be reached without improving food insecurity in many poor developing countries.

Investment in water

- There exists a dilemma between international commitments of investment in agriculture or water and actual investment.

Trade and food security

- A strong political-will should be put in place for facilitating the trade negotiation toward the establishment of international rules and principles of the food security.

Water democracy as an adaptation measure for the climate change impact

- The “**water democracy**”* has contributed to decision making on water management

How the “**water democracy**” can be rebuilt among the water users associations?

- It asks the farmers to recognize a value of water
- A collective action is only possible with a full participation and cooperation of farmers
- It needs to enhance the transparency in a process of decision making
 - Institutional arrangements should be put for a rebuilt of water democracy

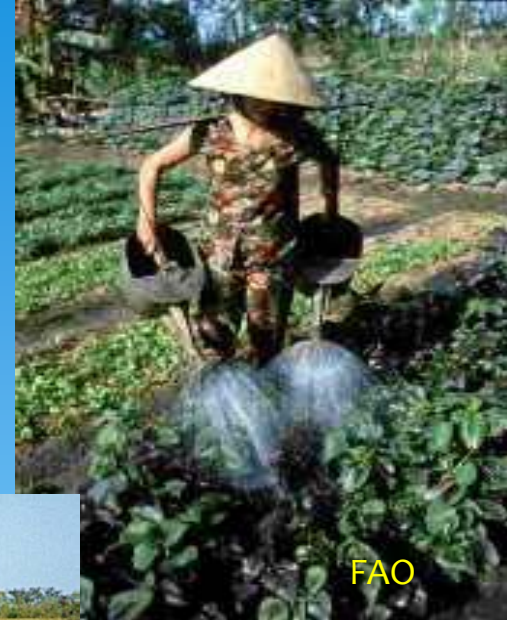
* Shiva,V.

Conclusions and issues for future discussion

The paper mainly focused on;

- Theoretical considerations on the water management and its implication of food security.
- Possible application of economic measures and institutional settings to coordinate a water conflict.
- The change of behavior of water users, namely farmers with a knowledge and understanding on a value of water and its scarcity.
- The issue linkage with the water management and food security.
- The allocation of water for the biodiversity for food insecurity and sustainable preservation of biodiversity and ecosystem.

Thank you!



Submitted: 2 December 2011

FAO