THE EVOLUTION OF IRRIGATED AGRICULTURE IN ASIA, AND PROSPECTS IN SE ASIA

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Presentation at the 10th New Ag International Conference
28 – 30 March 2012. Bangkok, Thailand

The demand for food, feed, fiber and bio-fuel is expected to more than double in Asia within the next 50 years. Furthermore, dietary demands are changing, generally to more water intensive foods, especially animal products such as milk, meat and eggs. The expanding and changing characteristics of production will require increased water supplies and especially those that are reliable. Water demands could as much as double by 2050 if we continue with business as usual (Molden, 2007).

More than any other continent, Asia's agricultural production capacity is based on irrigation. With roughly one third of the continent's cultivated land under irrigation, and approximately three quarters of the world's irrigated area, irrigation is fundamental to the food security of the region. Production of staple crops was boosted by over 135% from 1970 to 2007, and concurrently rural poverty was significantly reduced, in large part through intensification of production under irrigation (Mukherji et al, 2011).

While the earlier irrigation developments were primarily large scale public irrigation systems for the production of staple food crops, over the course of the past two decades the continuing expansion of irrigation has been primarily due to increasing development of small "atomized" systems where the control of the water supply is closer to the farmer, and which have allowed increased levels of productivity and diversification. Rather than diversions from large rivers and major reservoirs, the primarily sources of water for these later developments have been either groundwater or small surface storage. Groundwater, generally developed by the farmers themselves, is already the dominant source for irrigation water in South Asia, and is increasing in importance in areas of South East and East Asia.

This development of groundwater has led to major governance challenges in parts of South Asia where it is being over-abstracted. That said, with the growing demand for water in agriculture and the importance of reliable sources for higher value production, yet to be developed groundwater resources in more water abundant areas of the region, such as Eastern India and parts of South East Asia, present opportunities for increasing production. In addition, further investments in small scale storage at the farm and community levels, and re-configuration of existing large scale public systems are proving to be viable strategies for improving access to more reliable water supplies.

As with Asia as a whole, in South East Asia agriculture is by far the largest consumer of water, estimated to be 68% of total withdrawals in Viet Nam, and around 98% in Cambodia (WRI, 2009; Table 1). However, the proportion of irrigated land in in this region is relatively

low compared to other countries in Asia (ranging from 7% of total cropland in Cambodia to 31% in Viet Nam [World Bank, 2009a]).

Despite the relative abundance of renewable freshwater in the region, agriculture is vulnerable to local climatic variability, with significant risks from both floods and droughts, even under current climate conditions. Increasing and safeguarding expanding production will require continuing improvements in water management.

Table 1: Water and agriculture in selected countries in South East Asia

	Unit	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam
GDP from agriculture	% (2008)	32.5	32.1	46.7	11.6	22.1
Agricultural population	% (2006)	68	76	69	45	65
Arable land	km^2 (2007)	38,000	11,700	105,770	152,000	63,500
Arable land per capita	ha/cap (2007)	0.26	0.20	0.22	0.24	0.07
Arable land irrigated	% (2007)	8	26	21	33	47
Per capita water available	m^3/cap (2007)	33,537	57,914	21,613	6,462	10,338
Total water withdrawal	km^3/year	4.08	3.00	33.20	87.10	71.40
Per capita withdrawals	m^3/capita/year	308	555	711	1,412	877
Agricultural withdrawals	%	98	90	98	95	68
Industrial withdrawals	%	1	6	1	2	24
Domestic withdrawals	%	2	4	1	2	8

GDP = gross domestic product, km = kilometer, Lao PDR = the Lao People's Democratic Republic, m – meter/ Source: Adapted from Johnston et al. (2010).

Agricultural production growth in the region has been outstripping population growth (see Johnston et al., 2010 for a more detailed discussion of agricultural trends), and is becoming increasingly commercial. With total agricultural land in South East Asia having expanded by less than 5% in the past two decades, the increases in production have mostly come from intensification through improved seeds, fertilizer usage, production practices and irrigation. Most National Governments now view expanding the area under irrigation as key to further increasing production and reducing the climate-related risk to the agricultural sector. For instance, while Cambodia has less than 0.75 million hectares of irrigated land, this is three times what it was twenty years ago (Johnston et al, 2010).

The mega-deltas and floodplains of the Red, Mekong, Chao Phraya, and Irrawaddy rivers, produce half of the rice in the region and approximately 8% of the world supply. Traditionally wet season (May to October) rice with some supplementary irrigation was the main production system, but increasingly irrigated crops in the drier and less flood prone seasons have become the dominant systems. For instance, the wet season rice is now only 10% of the annual production. This trend increases the demand for reliable water supply during the periods when availability of water resources is lowest. Elsewhere in the region, the extent of development has been more varied. For example, while there remains further room for intensification, Thailand's investments in small to medium irrigation systems has increased dry season production in inland areas of the country. On the other hand, in

Cambodia a little more than one tenth of the annual rice production is grown outside the wet season (Johnston et al, 2010). The development of large areas for coffee in the Central Highlands of Viet Nam and the Bolavens Plateau of Lao has been made possible through irrigation from groundwater, but, as in South Asia, the groundwater in these locations is becoming over-exploited.

The extent to which agriculture has already intensified, specialized, and increased the use of inputs varies between and within countries in the region. China, Thailand and more recently Vietnam, already have relatively well developed commercial agriculture sectors, where there has been significant adoption of intensive small-scale irrigation technologies (drip irrigation, greenhouses, plastic mulches etc) for high value crops. Other countries, such as the Lao PDR and Cambodia, are at much earlier stages in this transition.

In Conclusion

Market demand for agricultural production will increasingly drive agricultural investments, and thereby determine the use of water resources. Meeting the region's food and other agricultural requirements over the coming decades will require significant increases in productivity, diversity and reduction of risk, which necessitates wide-spread adoption of improved agricultural water management approaches in both irrigated and rainfed systems. Investments in agricultural water management must focus on more flexible approaches, including small-scale, on-farm systems and groundwater irrigation that involves the relevant local communities. Of course, concurrent investments to facilitate access to markets are also required.

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