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Policy brief

2011, No. 11

Demand Analysis Scenarios for Supporting Catchment Irrigation Management in Cambodia[1]

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This study examines the possibility of supporting improved catchment irrigation management by evaluating scenarios based on sound hydrological analysis using the Water Evaluation and Planning (WEAP) model. The scenarios identify clear options and practical implications for irrigation management which can usefully inform policy makers and relevant stakeholders.

KEY MESSAGES

- Population growth and external market demand exert a constant upward demand for food. Rice production in the Tonle Sap basin is increasingly shifting from rain-fed mono-cropping to irrigated double or triple-cropping. This trend has greatly increased the demand for irrigation.
- The rapidly growing demand for irrigation has created and intensified competition for water resources, raising concern about the equity of water allocation, sustainability of water usage, social friction among water-user communities, long term sustainability of water resources and environmental impacts of irrigation.
- Government policy reform, including river basin management, is expected to address some of these concerns. However, sound water management requires good knowledge and applicable tools to support well informed decision making.
- Traditional supply-based water planning is no longer appropriate. Instead, planning for water-supply projects should focus on demand-side water management. Three demand management scenarios were evaluated in this study. The results are summarised in the following discussion.
  - The reference scenario simulation shows that the catchment can potentially irrigate an area of 10,367 ha. However, allowing 30 percent of annual stream flow for environmental in-stream flow requirement, this irrigated area will face unmet demand of 4.2 million m^3 mostly in June (0.95 million m^3 in March).
  - The additional reservoir storage scenario concludes that the reservoirs in Stung Chrey Bak catchment are small and can barely help improve unmet demand in times of drought.
  - The increased irrigation-demand scenario simulation (5 percent per annum from 2008 to 2016), where it is estimated that the irrigated area will have reached about 16,083 ha by 2016, highlights two main implications for catchment planning: (i) without considering environmental in-stream flow and climate variability, unmet irrigation demand will be 2.97 million m^3 in March and June; and (ii) allowing 30 percent of annual flow for environmental in-stream flow and other uses would increase unmet demand to 7.89 million m^3, mainly in June (1.3 million m^3 in March).

Taking into account environmental in-stream flow and other uses, the irrigated area should be limited

1 This policy brief is based on a CDRI working paper, *Hydrological Analysis in Support of Irrigation Management: A Case Study of Stung Chrey Bak Catchment, Cambodia*, by Chem P., P. Hirsch and Someth P.
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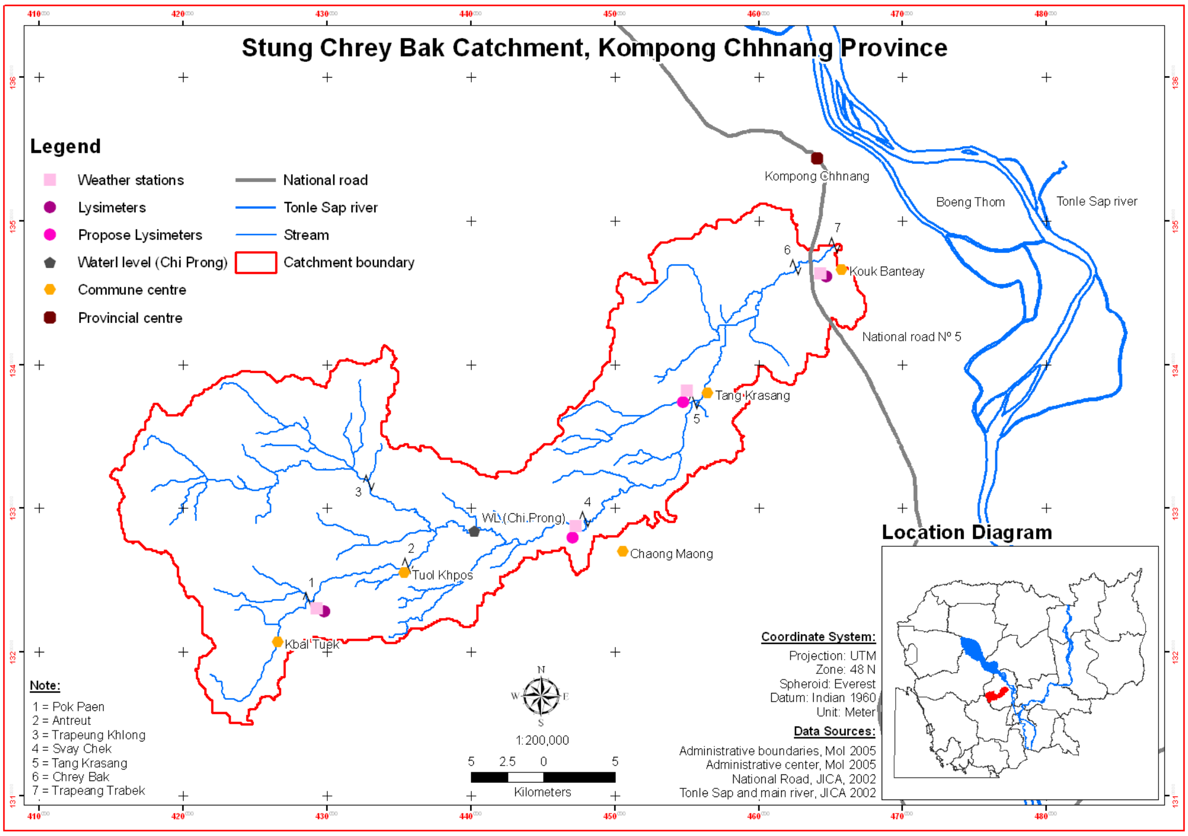
Figure 1: Map of Stung Chrey Bak Catchment



Source: Chem *et al.* 2011

to 10,000 ha. Alternatively, when environmental in-stream flow is considered a secondary priority, the irrigated area should not be expanded beyond 12,000 ha unless irrigation infrastructure and water governance practices are improved.

CASE STUDY: STUNG CHREY BAK CATCHMENT

Stung Chrey Bak catchment is a sub-catchment of the Tonle Sap Basin (Figure 1). The Stung Chrey Bak main stream flows into the Tonle Sap River. Seven irrigation schemes supply water to a rice cultivation area of 10,367 ha. The four schemes (numbered 1 to 4) in the upstream part of the catchment supply supplementary irrigation for wet season rice, whereas the three downstream ones (5-7) irrigate both wet and dry season rice cultivation.

Rice farming has changed rapidly from rain-fed mono-cropping to irrigated double or triple-cropping. A number of irrigation schemes have been built to extract water from the stream so that rice can be grown without being heavily dependent on rainfall. Recent developments have increased the dry season rice cultivation area to 741 ha around schemes 5, 6 and 7. Because the area irrigated by scheme 7 is flooded during the wet season, it is only suitable for growing dry season rice. Some areas have faced water shortages, and competition for irrigation water between schemes 5, 6 and 7 has been intense, especially in the months of February, March and June (Chem & Someth 2011).

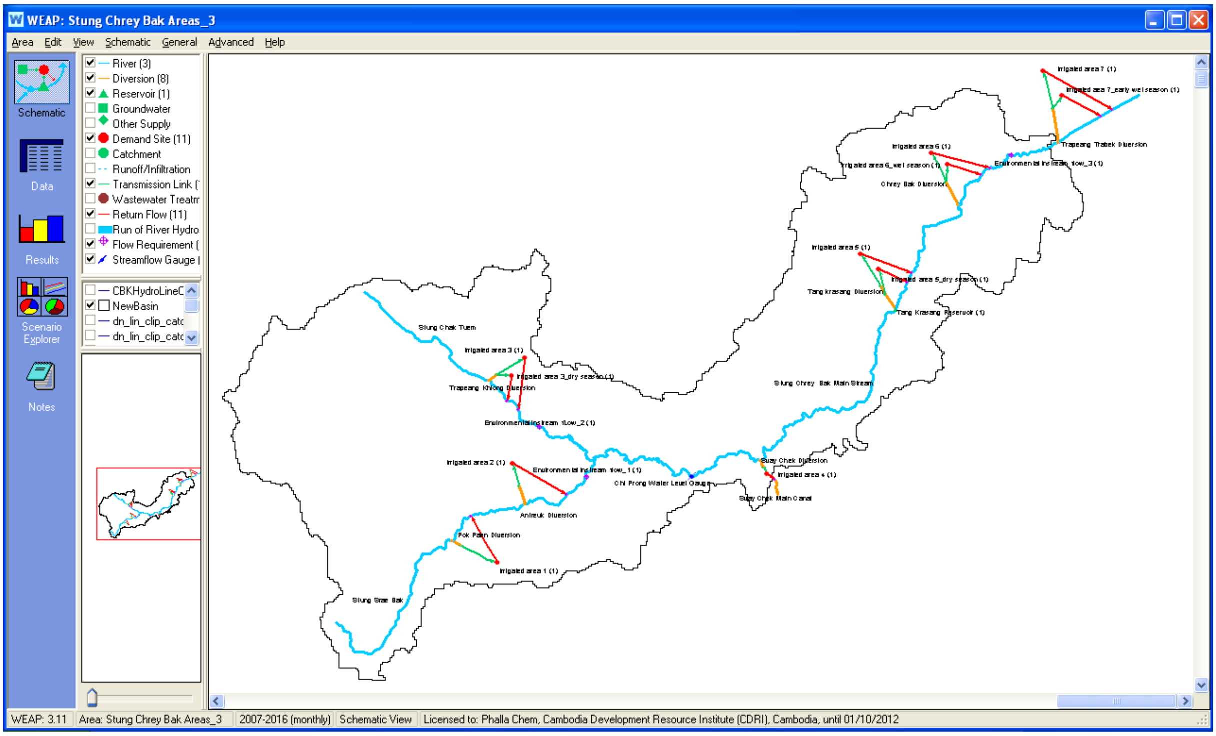
WEAP (Water Evaluation And Planning System)

WEAP can be used to: (1) define modelling problems; (2) establish the current account[5] as a base for scenarios; (3) build scenarios; and (4) evaluate scenarios against several criteria such as water availability and environmental conditions (Sieber & Purkey 2001; Yates *et al.* 2005). A WEAP schematic map of Stung Chrey Bak catchment is presented in Figure 2.

The research team used WEAP to establish the current account and three scenarios: reference,

5 The current account is a presentation of the existing water system; in this case, it represents the Stung Chrey Bak catchment in Cambodia. It is to calibrate the data and assumptions and accurately reflect the actual operation of the catchment system.

Figure 2: WEAP – Stung Chrey Bak Catchment



Source: Chem *et al.* 2011

annual increase in irrigation demand, and additional reservoir storage. These scenarios were evaluated against actual water availability in the catchment. Key assumptions are:

- In the reference scenario, 1 percent of irrigation demand can be saved by implementing operational and infrastructure improvement programmes and better water governance. There is no increased irrigation demand in this scenario.
- In the increased irrigation scenario, demand increases 5 percent per year from 2008 to 2016.
- In the additional reservoir storage scenario, the current reservoir storage in scheme 5 is added to the irrigation supply. This scenario also includes the five percent annual increase in irrigation demand from 2008 to 2016.
- Environmental in-stream flows are 30 percent of annual stream flows. The environmental in-stream flows were not considered in the current account year (2007).

RESULTS AND DISCUSSION

In 2007, stream flow was calculated as 288.5 million m^3 and the irrigated area was reported to be 10,367 ha. The lowest stream flows in the dry season measured in the mid-catchment area were 4 million m^3 in March and 5.6 million m^3 in February. The lowest stream flow recorded in the wet season was 12.91 million m^3 in June (Chem & Someth 2011).

- First, without considering in-stream flow requirements, the water in the Stung Chrey Bak catchment is just sufficient to irrigate the reported current irrigated area of 10,367 ha (741 ha in the dry season).
- Second, allowing 30 percent of annual stream flow for environmental in-stream flow, and given the command area of 10,367 ha, unmet demand will be 0.95 million m^3 in March and about 3.3 million m^3 in June.
- Third, if the command area increases by 5 percent per annum from 2008 to 2016, by which time it would have expanded to 16,083 ha, and allowing 30 percent of annual stream flow for environmental in-stream flow, unmet demand would be around 1.32 million m^3 in March and 6.57 million m^3 in June (Figure 3).
- Only irrigation scheme 5 has reservoir storage; however, with a capacity of just less than 1 million m^3 it has no significant impact on meeting unmet demand.

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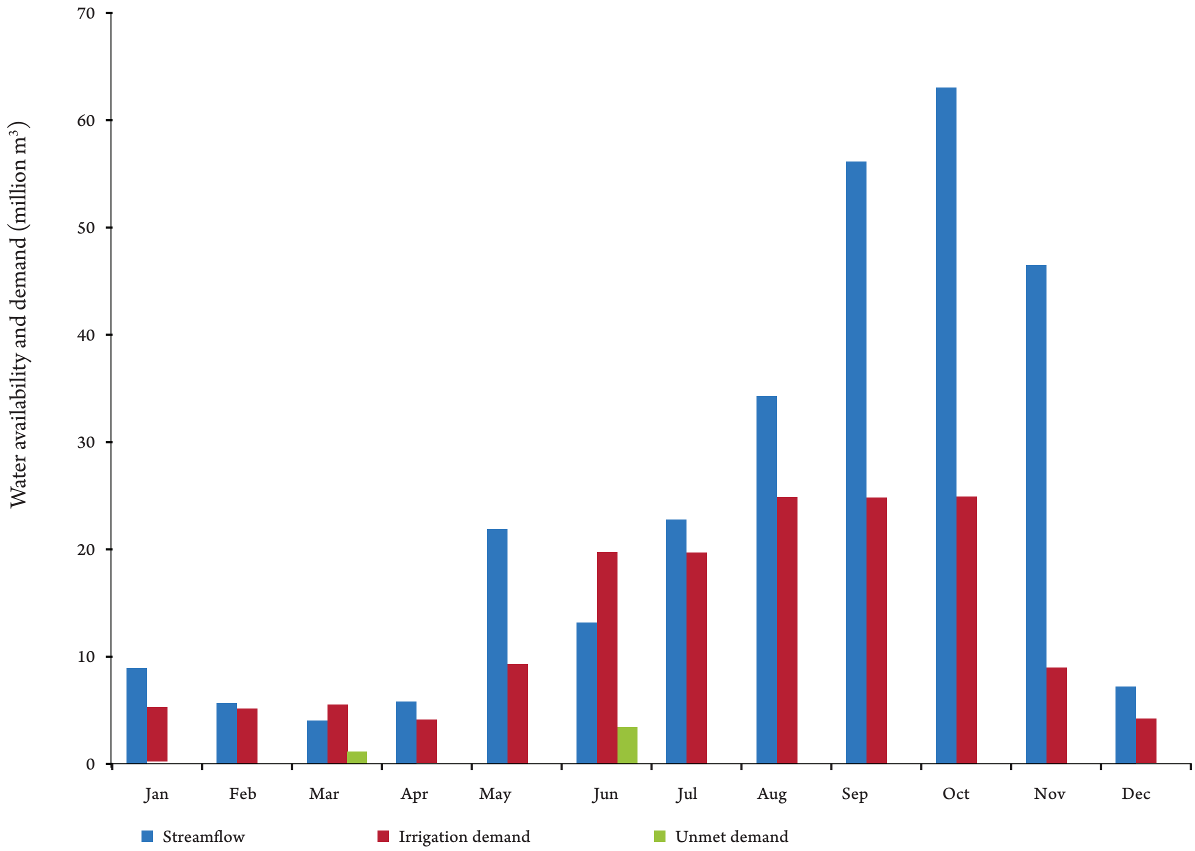
Figure 3: Relationships between Supply-demand and Unmet Demand: Annual 5 percent Increase in Irrigation Demand Scenario



Source: Chem *et al.* 2011

In conclusion, taking environmental in-stream flows into account, the irrigated area should be limited to 10,000 ha. On the other hand, without considering environmental in-stream flow, the irrigated area should not exceed 12,000 ha (including dry season crops) unless appropriate water resources management measures are taken to avoid water depression within the catchment.

REFERENCES

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