Comparative Water Law, Policies and Administration in Asia: Evidence from 17 Countries

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ABSTRACT

Conventional wisdom suggests that improving water governance is the key to solving water insecurity in developing countries but there are also many disagreements on operational and methodological issues. In this paper, we build on the work of Saleth and Dinar and surveyed 100 water experts from 17 countries in Asia to compare 19 indicators of water laws, policies and administration among and within countries from 2001 to 2010. We present the results of our study in a comparative dashboard and report how water governance indicators vary with a country's level of economic development, which ones do not and how and why some indicators change overtime in some countries. We have two main results. First, our initial findings suggest the possibility of water Kuznet's curve i.e. certain water governance indicators vary with a country's level of economic development. However, more studies are needed given the caveats and limitations of our study. Second, the results have practical value for policy makers and researchers for benchmarking with other countries and tracking changes within their countries overtime. We conclude with implications for a second-generation research agenda on water governance.

1. Introduction

Improving water governance is widely regarded as the key to solving water insecurity problems in developing countries [*Rijsberman and Zwane, 2008; Rogers and Hall, 2003; Briscoe, 2009; Hoekstra and Chapagain, 2006; Kashyap, 2004; Saleth and Dinar, 2005; Gopalakrishnan, Tortajada, Biswas 2004; Biswas, 2010; Tortajada, 2010; Asian Development Bank, 2004; Global Water Partnership, 2000]*.

However, despite its importance, there remains little consensus amongst water scholars on a number of issues (see *Araral and Wang*, forthcoming, for a review). First, there is no consensus on the scope, definition and measurement of water governance, see for example contrasting definitions from *Global Water Partnership* (2002), UNDP Water Governance Facility, *Biswas and Tortajada* [2010] *and Rogers and Hall* [2003], among others. The *Global Water Partnership* [2002] defined water governance as "the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society."

This definition, however, is problematic because practically the entire literature on water policy, economics, finance, politics, regulation, law and management would fall under this definition. At the minimum, this definition suffers from a specification problem i.e. the mechanisms to develop and manage water resources are often not well specified and thus their operational implications for research and governance reform are unclear. We provide an alternative operational definition of water governance in terms of various dimensions of water law, policies and administration that have been commonly regarded in the literature as important

72 determinants of performance. These include water rights, pricing, decentralization,
73 accountability, integration, private sector participation, user group participation and
74 organizational basis of water management, among others.

75 Second, water governance has largely been studied in terms of disciplinary orientations -
76 i.e. political sociology [*Mollinga, 2008*], institutions [*Pahl-Wostl, et. al., 2007*], institutional
77 economics [*Saussier, S. and Menard, C. 2000; Shirley, 2002*], international relations [*Konca,*
78 *2005*] and welfare economics [*Rogers and Hall, 2003*], among others. As a result, the literature
79 has not evolved into a multi and inter-disciplinary agenda despite the fact that water governance
80 should be inherently multidisciplinary in orientation. We address this issue by taking a multi-
81 disciplinary approach to water governance by integrating water law, policy, economics, and
82 administration.

83 Finally, scholars remain divided on how to approach the study of water governance.
84 Some scholars such as *Saleth and Dinar* [2005] employs a comparative approach, others use
85 single case studies such as *Gain and Schwab* [2012] while *Biswas and Tortajada* [2010] propose
86 an alternative approach based on independent and objective case studies of good practices
87 particularly of "the enabling environment and critical factors of success."

88 In this paper, we build on the work of Saleth and Dinar by providing an in-depth and
89 nuanced comparison of 19 indicators of water governance for 17 countries in Asia based on
90 income levels as well as inter-temporal analysis within countries from 2001/2002 to 2009/2010.
91 Second, we collected additional 49 survey responses in 2009~10 to increase the sample size to
92 100 respondents and strengthen the robustness of Saleth and Dinar's work. Third, we added three
93 countries - Singapore, Uzbekistan and Mongolia - which were previously not covered in the

94 Saleth and Dinar survey. Fourth, we provide insights to explain the significant changes in water
95 governance practices in selected countries between 2001 and 2010. Finally, we outline the
96 implications of the paper for a second-generation research agenda on water governance.

97 The paper is organized as follows. In the next section, we describe the framework, data,
98 methods and analysis for the study. This is followed by discussion of the findings and analysis
99 and the paper's conclusion and implications.

100 ## 2. Framework, Data, Methods and Analysis

101 ### 2.1 Conceptual Framework and Variables

102 We build on the conceptual framework originally developed by *Saleth and Dinar* [2004],
103 which consists of three dimensions, namely water law, water policy, and water administration.
104 Table 1 summarizes the components and the definitions of these three dimensions of water
105 governance. Most of the variables in our study are ordinal variables while three are nominal
106 (discrete) variables. The components were chosen to represent the concept of water governance
107 as they have been frequently cited and debated in the literature and in policy discussions [*Dinar*
108 *and Saleth*, 2005] as well as being part of the widely accepted Dublin Principles on Water
109 Management. The variables are also amenable to direct policy manipulation, which makes them
110 even more appealing.

111 ### 2.2 Sample Data and Questionnaire

112 Our research data is based on two time periods: the 2001~02 survey by *Saleth and Dinar*
113 [2004] and the 2009~10 survey by this study. Taken together, the respondents of these two
114 surveys encompass 100 water professionals from 17 countries in Asia. The use of expert opinion
115 has been the conventional method for constructing composite indices over the years because

116 objective information is rare or unattainable for qualitative concepts like water institutions.
117 Studies that systematically compare various dimensions of water governance *across countries*
118 are rare and therefore a comparative survey would be valuable.

119 While there are many studies on water governance institutions, they have serious
120 limitations: 1) they do not allow for a more systematic comparison across countries of varying
121 levels of economic development; 2) they do not allow for systematic comparison overtime; and
122 3) they are not cost effective i.e. we have to pull together close to 1600 data points given the
123 number of indicators and sub-indicators that we wanted to compare (at least 40) and the number
124 of countries we were comparing (19) across two time periods. Therefore, because of these
125 limitations, the use of comparative survey data from water experts helps address these
126 limitations.

127 Popular examples of composite indices using expert judgment include the widely
128 recognized Corruption Perception Index (CPI) by the Transparency International, the governance
129 indicators developed by *Kaufmann et al*. [2003], and the competitiveness indicators developed
130 by the *World Economic Forum* [1997]. Numerous studies show that such qualitative indices
131 exhibit behavioral consistency with their linked "objective" performance measures when they are
132 correlated against each other. This consistency indicates and reinforces the pertinence of such an
133 approach [*Clague,* 1994,1997; *Kaufmann* et al., 2003]. The details of the country coverage and
134 the response frequency per country for the two time periods are shown in the Table 2. The
135 countries that appear in both surveys are Bangladesh, Cambodia, People's Republic of China
136 (PRC), India, Indonesia, Japan, Lao PDR, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, and
137 Vietnam.

[Table 2 here]

Out of the total 100 survey responses, 51 came from the Asian portion of the 2001~02 survey. The remaining 49 were collected by this study in 2009~10. We essentially used the same questionnaire as Saleth and Dinar to enable inter-temporal comparison of changes in water governance. The questionnaire used in 2009~2010 can be found in an online survey link (http://www.surveymonkey.com/s/7WVPGRV). The questionnaire used by the Saleth and Dinar can be found in Appendix A of *Saleth and Dinar* [2004]. In the 2001~02 survey, 48% of the respondents are engineers, 32% are economists, and the rest are either lawyers or social scientists of various kinds (we were unable to isolate the profile for the Asian portion of the Saleth and Dinar sample; as such, the above profile is based on the entire sample).

In the recent survey, 53% are engineers, 27% are government officers who are not engineers, 8% are economists, 6% are academicians, and the remaining portions are lawyers, businessmen, and information technologists. This trend in profile is more or less consistent with the existing disciplinary composition found in the water sector of most countries [*Dinar and Saleth, 2005*]. The names of the participants of the recent survey are available with the authors.

There are three mechanisms to ensure reliability of the survey responses. First, the respondents were selected based on their responsibilities and years of experience in the water sector in their countries. Thus we have respondents who are managers and leaders of water utilities, regulatory bodies, water apex bodies, water ministries, academics and the private sector, among others. Second, the responses we obtained came from a pool of expert respondents so standard errors are distributed. Third, we also reported our sample frame and standard deviations so readers can judge the reliability of the responses.

2.3 Methods of Analysis

We employ four methods of analysis. First, for the 16 ordinal variables in our data set (see Table 1 for coding), we used the mode as our measure of central tendency by country and for each of the survey periods (2001/2002 and 2009-2010). We did not use the mean because it is not a meaningful measure for ordinal variables and the median is not appropriate given the small sample size. Our survey questionnaire originally used a more variable ordinal scale (i.e. 0 to 100) because the plan was to construct a water governance index. Since we have dropped this plan in favor of simply reporting the raw scores, we decided to normalize the ordinal scale from 0 to 100 to 0-10 by simply dividing the raw scores by 10 and rounding up to the nearest unit. The results are the essentially the same but our normalization has made it easier to compare the results across countries and within countries overtime. For nominal variables such as water rights (L2), project selection criteria (P1) and organization basis of water administration (A1), we asked respondents to choose among the options given and used the mode for data analysis.

Second, we report in a comparative table (dashboard) the scores for each of the 19 water governance indicators for both time periods for all of the countries covered in the survey. Third, using these raw scores from step 2 above, we compared the weighted means and standard deviations in 19 areas of water governance amongst the 17 countries based on income levels (low, middle and high incomes). The mean of subgroup central tendencies can be computed as a weighted mean (Huck 2008). Based on the World Bank's (2012) definition, the low-income countries in our data set include Nepal, Bangladesh, Cambodia and Laos. Middle-income countries include Mongolia, Pakistan, Uzbekistan, India, China, the Philippines, Thailand, Vietnam and Indonesia while high-income countries include Singapore, S. Korea, Taiwan and Japan.

We note in particular the means and standard deviations amongst countries and within countries between the two time periods. We paid attention to cases when variations are relatively significant, in this case defined as having more than 4 points difference. This threshold is arbitrary but is nonetheless meaningful. We included in our analysis those cases where there are more than 4 responses and dropped from the inter-temporal analysis cases involving only 1 respondent and those without comparative data from the 2001/2002 survey period.

Finally, we interpreted these significant changes from 2001/2002 to 2009/2010 based on objectively verifiable developments in water governance for selected countries, for instance the introduction of water laws during this period that could have changed perceptions about water governance. We found that most improvements in water governance, say improvements in accountability, greater private sector participation, more integrated approach to water governance, etc. can in fact be explained by the introduction of new water laws, policies and practices in these countries since 2001.

2.4 Improvements from Saleth and Dinar

We extend the framework and methods pioneered by Saleth and Dinar in five novel and supplementary ways. First, we collected additional 49 survey responses in 2009~10 in addition to the 51 respondents from the Saleth and Dinar survey. This helps to strengthen the robustness of Saleth and Dinar's work. Second, we added 3 countries - Singapore, Uzbekistan and Mongolia - which were previously not covered in the Saleth and Dinar survey. Singapore is a useful benchmark country for its best practices in integrated urban water governance.

Third, we provided an in-depth and nuanced comparison of water governance practices among countries based on income levels. Fourth, we provided an inter-temporal analysis within

206 countries for two time periods (2001/2002 and 2009/2010) to understand which aspects of water
207 governance has evolved in some countries in during this period. This paper therefore helps
208 provide a more nuanced (but not perfect and complete) understanding of water governance
209 among countries in Asia and a framework to compare and learn among and within countries
210 overtime.

211 **2.5 Caveats**

212 There are several limitations to our study. First, it would have been ideal if the size of the
213 survey sample were larger for some countries such as China, India, Indonesia, Bangladesh, and
214 Pakistan. However, because of time and budget constraints, we leave this for future research.
215 Nonetheless, this limitation should have been moderated largely by the reliance on key
216 informants, in this case water expert, to obtain the survey data.

217 Second, care has to be taken in interpreting the results for large countries for they are
218 limited to the concerned provinces or states included in the survey rather than for the country as
219 a whole, for instance China, India, and Pakistan. Future studies would have to collect more data
220 at the provincial or state level to account for the fact that water is often a local good.

221 Third, systematic comparison can provide a more nuanced but not perfect picture of the
222 state of water governance among countries in Asia and within countries overtime. Comparative
223 study of water governance across countries and overtime is conceptually and methodologically
224 challenging (but not impossible) to undertake. Fourth, our sample size for high-income countries
225 (Singapore and Japan) is not representative of other high-income countries in Asia (Taiwan and
226 S. Korea). Caution would have to be warranted in their interpretation. Finally, we did not test for

227 the statistical significance of measures of central tendency and variations because of the
228 relatively small size of our sample. This will be left for future research.

229 ## 3. Results and Discussion

230 ### 3.1 Overall Finding

231 The survey results for the 17 countries for the two time periods (2001/2002 and 2009-
232 2010) are summarized in a comparative table or dashboard (Table 3) for each of the 19 indicators
233 of water governance. We discuss the results in the section that follows.
234
235 [Table 3 about here]
236

237 ### 3.2 Variations among countries

238 Table 4 provides comparative summary of various governance indicators amongst the 17
239 countries covered in the survey. For ease of comparison, we refer back the reader to Table 1 for
240 an operational definition of our variables. We were interested to see how water governance (law,
241 policy and administration) varies with a country's level of economic development as well as
242 overtime.
243
244 [Table 4 here]
245

246 In summary, our preliminary findings in Table 4 show that, not surprisingly, various
247 aspects of water laws, policies and administration vary with a country's level of economic
248 development. This result is consistent with *Briscoe's* [2009] hypothesis about the positive

correlation between a country's level of economic development and its state of water governance. This result, if further confirmed by more studies, suggests a similarity to water Kuznet's curve (WKC), i.e. the overall quality of a country's water governance is a function of average income. By implication, as a country's average income increases, its quality of water governance is also expected to increase. As we explain the succeeding sections, this appears to be the case for certain aspects of water law, policy and administration.

Variations in Water Law

We find positive correlation between a country's level of economic development and aspects of its water laws, for instance with 1) legal accountability (L3) for water sector officials (9.3 vs. 4.7, 4.3 for high, low and middle-income countries, respectively); 2) tendency towards centralization (L4) of water governance (8 vs. 4.6, 4.5); and 3) more integration of water laws (L6) with other laws on land, forest, and environment (7 vs. 4.3 and 3.9). These variations in water laws among high, middle and low income countries could simply be the result of more developed legal systems for countries with higher levels of economic development (i.e. spill-over effect).

In particular, the positive correlation between legal accountability and economic development is consistent with the water governance literature, for instance *Tortajada* [2006] in Singapore, *Anbarci, Escaleras, and Register* [2009] in the case of access to drinking water in 85 countries, *Davis* [2004] in South Asia and *Estache A., Plummer and Cross* [2007] in Africa. More generally, this is consistent with the empirical literature on governance i.e. high-income countries also tend to have stronger legal systems, see for instance the World Bank Governance Index (2008). The findings on greater decentralized water governance in lower income countries

271 is consistent with the literature, for instance [*Vermillion, 1997*] based on a meta-analyses of 29
272 irrigation studies.

273 We also see a sign of negative correlation between a country's level of economic
274 development and participation (L5) in water governance (5.4 vs. 4.2, 2.0 for low, middle and
275 high-income countries, respectively). This is possibly because of the importance of irrigation
276 (and farmer managed irrigation) in lower income countries [see *Lam, 1998*; *Vermillion, 1997*] as
277 well as the importance urban poor water associations in managing water supply in slum areas
278 [*McIntosh, 2003*].

279 However, we find two aspects of water law that do not vary systematically with a
280 country's level of economic development: First, the format of surface water rights (L2) in all
281 countries varied considerably from common or state property to multiple rights, riparian system,
282 appropriative rights, among others, but state property is the most common. This wide variation
283 reflects the unique circumstances that led to the evolution of these rights such as the legal
284 tradition and precedents of a country, its size, geography and water endowments, importance of
285 indigenous water rights and the country's political system, among other factors. Multiple use
286 water rights is not surprising, for instance see *Bruns, Ringler and Meinzen-Dick* [2005] for a
287 more exhaustive conceptual and comparative analysis; *Haisman* [2005] in Australia and *Lui*
288 [2005] in China.

289 Second, the legal distinction (L1) of different water sources (ground, surface and rain) do
290 not vary systematically with levels of income but perhaps could be better explained by a
291 country's geography, legal origins and administrative structure. For instance, in middle-income
292 countries (Philippines and Indonesia), variations in the legal distinction of different sources can

293 be explained by variations in the administrative structure of water governance i.e. there are
294 separate agencies dealing with different types of water sources.

295 **Variations in water policies**

296 In terms of water policy, we find that a country's level of economic development vary
297 with water pricing (P3) with richer countries pursuing more cost recovery (as water tends to be
298 more affordable in these countries); the extent of linkages between water law and policy (P6),
299 and availability of finance for water investments (P8).

300 *Dinar (ed)* [2000], based on meta-analyses from 30 countries, concludes that variations in
301 water pricing among countries are largely a function of political economy factors than a
302 country's level of economic development. Lower income countries pay more attention to issues
303 of water and poverty (P7) compared with middle and higher income countries, see for instance
304 *McIntosh* [2007] for a guidebook on improving water access to the urban poor in Asia.

305 However, we find little consistent trend among high, middle and low-income countries in
306 terms of 1) project selection criteria (P1) (i.e. use of benefit cost analyses, although there are
307 questions if this is actually done in practice) and 2) the extent to which other (non-water) policies
308 have a significant influence on water policy (P2). This fragmentation is not surprising and is a
309 common critique of scholars of water governance, for instance *Biswas* [2004]. In the case of
310 water utilities privatization, *Clarke, Kosec and Wallsten* [2004] and *Hall & Lobina* [2006] find
311 mixed results worldwide with more challenging experience from developing countries.

312 We also find that a country's level of economic development vary inversely with the
313 extent of private sector participation (P4). It is possible that as a country becomes richer, its
314 public sector becomes equally if not more capable than the private sector in implementing water

315 investment projects. Conversely, in poorer economies, the public sector is relatively weak and
316 hence may have to rely more on the private sector to implement investment projects.

317 **Water Administration**

318 Finally, in terms of water administration, we find - not surprisingly - positive correlation
319 between a country's average income and certain aspects of water administration such as 1)
320 functional capacity and balance (A2) among water agencies; 2) use of adequate and reliable
321 water data for planning (A4); and 3) application of science and technology (A5) to solve water
322 governance problems.

323 Interestingly, we found that water apex bodies (A3) are more pronounced in low income
324 than high-income countries. There are no clear explanations in the literature for this finding but
325 we speculate that this can be due to the influence of aid agencies in shaping water policies in
326 developing countries. Also, we do not find systematic variations between organizational basis for
327 water (A1) (i.e. geographic, hydrologic, river basin, mixed) and levels of economic development
328 reflecting the unique evolution of institutions in these countries [*Saleth and Dinar*, 2005; *Bruns,*
329 *Ringler and Meinzen-Dick*, 2005].

330 **3.3 Variations within countries overtime (2001 and 2010)**

331 An important contribution of this paper is to explain variations in water governance
332 within countries between 2001 and 2010. We examined in more depth the cases of several
333 countries - the Philippines, Cambodia, Vietnam, Indonesia and Thailand - to see if there were
334 indeed significant water governance reforms that occurred during this period. We left out in the
335 in-depth analysis countries with single respondents and without follow up survey in 2009/2010.
336 These include Taiwan, S. Korea, Mongolia, Uzbekistan and New Zealand. We also left out

China and India in this analysis because the respondents in both time periods come from different provinces / states and thus inter-temporal comparison is not reliable.

We find significant changes in many aspects of water governance within countries between these two time periods particularly in Cambodia, Vietnam and Indonesia but not as much in the case of the Philippines and Thailand. We attribute these significant changes to broader national economic, social and political reforms happening in these countries during this period, which is consistent with the hypothesis of *Saleth and Dinar* [2005] and *Bruns, Ringler and Meinzen-Dick* [2005]. At the onset, it has to be pointed out that these changes are largely *de jure* than *de facto*. Future studies would have to more systematically look at the actual implementation of these laws and what difference would they really make in terms of water sector performance.

In the case of Cambodia, of the 17 countries covered in the survey, it reported one of most significant changes in water governance since 2001 as a result of the introduction of a comprehensive water resources law in 2007. Changes in water governance indicators that can be attributed directly to the new water resources law includes changes in the legal distinction of different water sources (L1), legal accountability of water sector officials (L3), legal framework for integrated treatment of water sources (L6), linkage between water law and water policy (P6), accountability and regulatory mechanisms (A4), and use of science and technology in water governance (A6). Most of these changes were also the result of success of the internationally acclaimed Phnom Penh Water Supply Authority (PPWSA) - one of the most successful water utilities among developing countries. PPWSA is particularly known for the significant improvements it has introduced in the areas of accountability, integration and use of science and technology in water governance [see for example *Araral, 2008*].

Indonesia, like Cambodia, is one of the 17 countries with the most significant changes in water governance since 2001, mainly due to the large scale national reforms introduced in the country during the period of *reformasi* (1998-2003). These reforms include decentralization to local governments (indicator L4), privatization and liberalization (indicator L5), strengthening of mechanisms of accountability (indicator L3) with the creation of the constitutionally powerful anti-corruption agency (KPK), among others.

In addition, Indonesia likewise adopted a new water law in 2004, which has implications for indicator L1 (Legal Distinction of Different Water Sources) and L2 (Format of Surface Water Property Rights, among others. In short, the significant changes in the survey results from 2001 to 2010 in Indonesia can actually be explained by changes in water law, policy and administration over this period.

In Vietnam, several indicators of water governance also had significant changes from 2001 to 2010. These include L1 (Legal distinction among water sources), L5 (private sector participation), P2 (linkages between water law and policy); P7 (attention to poverty) and P8 (availability of finance for water investments). Again, these changes can be explained by changes in water laws, policies and administration as a result of the 2006 National Strategy on Water Resources and strengthened by 2005 decrees on river basin and enforcement of water regulations.

This strategy articulated a number of priority areas for reform, namely 1) national water resources inventory, assessment and water resources database / information system (indicator A5); 2) integrated water resources management (domestic use, irrigation and hydropower) (indicators L1, P2 and P6); 3) development of inter-reservoirs regulations in important river basins; 5) ground water protection in the major cities; and 6) use of economic instruments on

383 water resources management (P1 and P3). Not surprisingly therefore, water governance ratings
384 for Vietnam significantly changed in these parameters during this period.
385 The Philippines and Thailand also saw significant changes in their water governance
386 since 2001 although not as extensive as Vietnam, Cambodia and Indonesia. In Thailand,
387 significant changes from 2001 to 2010 were reported in the following indicators: accountability
388 of water sector officials, decentralization, integration and project selection. Respondents from the
389 2010 survey in Thailand point to the recent catasthropic flooding of the Chao Phraya River as
390 evidence of the problems of accountability among the provinces in the river basin, inappropriate
391 decentralization of water governance resulting in too little integration of water management at
392 the basin level as well as problematic practices in project selection criteria for water
393 management.
394 In the case of the Philippines, out of the 19 water governance indicators, only two
395 indicators had significant changes from the 2002 to 2010 period. The first is the presence of an
396 effective apex of water bodies, in this case the National Water Resources Board, the Local Water
397 Utilities Administration and the River Basin Control Office at the Department of Environment
398 and Natural Resources, which was a recent creation. The second significant change - a stronger
399 legal distinction of different water sources - is an offshoot of having stronger regulatory water
400 agencies, which are able to enforce regulations related to ground water, surface water and river
401 basin water.
402 This last point is corroborated by a 16-point increase in the score on regulatory
403 accountability (indicator A4). In addition, because of stronger roles for river basin organizations
404 in the country, the rating for decentralization indicator (L4) likewise increased by 28 points after
405 the passage of regulations on river-basins. All of these suggest that changes in perceptions on

406 water governance in the Philippines from 2001 to 2010 can be attributed to actual governance
407 changes - more effective water apex bodies and decentralization to river basin organizations.

408 **4.0 Conclusions and Implications**

409 We compared water governance practices among and within countries in Asia from 2001
410 to 2010 by extending the framework and methods pioneered by Saleth and Dinar in five novel
411 and supplementary ways. We surveyed an additional 49 expert respondents in 17 countries and
412 added 3 new countries. We then provided in-depth and nuanced comparison of water governance
413 practices among countries based on income levels and undertook an inter-temporal analysis
414 within countries for two time periods (2001/2002 and 2009/2010).

415 There are two main contributions of this paper. First, we have provided a more nuanced
416 (but not a complete and perfect) picture of water governance in 17 countries in Asia. We find
417 that many aspects of water laws, policies and administration are positively correlated with a
418 country's level of economic development. We find this to be the case in 1) water law (legal
419 accountability for water sector officials, centralization tendency and integration of water laws
420 with other laws); 2) water policies (water pricing, extent of private sector participation, extent of
421 linkages between water law and policy, and availability of finance for water investments) and 3)
422 water administration (functional capacity and balance among water agencies; use of adequate
423 and reliable water data for planning and application of science and technology). We, however,
424 find a negative relationship between a country's level of economic development and extent of
425 private sector participation in water governance.

426 Although these findings are intuitively expected, as far as we know, this is the first
427 systematic comparative study of this kind in the literature. Our initial findings suggest the
428 possibility of water Kuznet's curve i.e. water governance indicators vary with a country's level

429 of economic development. This result supports *Briscoe's* [2009] hypothesis about the positive
430 correlation between a country's level of economic development and its state of water
431 governance. However, more studies are needed to confirm our initial findings.

432 In contrast, we do not find correlation between a country's level of economic
433 development and several aspects of water governance: legal distinction different water sources,
434 format of surface water rights, project selection criteria, the extent to which other (non-water)
435 policies have a significant influence on water policy, organizational basis for water and presence
436 of water apex bodies. Because of our small sample size, caution is warranted in making
437 generalizations about the statistical significance from these findings.

438 However, the patterns of water governance arrangements that we observed in this study
439 cannot be simply generalized to other countries because governance practices evolve, as we have
440 discussed throughout the paper, according to the unique political, historical, legal, administrative,
441 geographic and economic circumstances of a country, see for instance *Shah* [2003] et al. More
442 studies are needed to make conclusive remarks about the evolution of these patterns of water
443 governance.

444 Still, comparison is useful in helping water policy makers learn from and benchmark
445 with the practices of other countries. For instance, Singapore has shown a successful example of
446 integrated water resources management. Manila has shown an example of successful large-scale
447 water utilities privatization and improving service to the urban poor. Phnom Penh has shown best
448 practices in public water utilities and reducing non-revenue water. China has shown a successful
449 example of integrated river basin management in the Yellow River.

450 Second, we have tested and replicated a framework and methodology to compare and
451 learn about water governance *within countries overtime*. We found significant changes in water

452 governance from 2001 to 2010 in some of countries we surveyed but not in others. We argue that
453 many of these changes can be traced to broader developments in governance in that country –
454 political decentralization, privatization and liberalization, among others - mostly with donor
455 pressure for reform.

456 We now conclude by highlighting several potential prospects for future research in water
457 governance. First, evaluating the impacts of governance reforms is an important area for future
458 research because very few rigorous impact assessment studies exist despite the fact that most
459 scholars agree on its importance. For a start, this study has highlighted several questions for
460 impact assessment. For instance, what difference does it really make to have a more integrated
461 approach to water management? Here, Singapore would be a good case to study. Are there
462 examples of successful and cost effective integrated water management in developing countries?

463 Second, what is the impact of having a clearer legal distinction of different water sources
464 or having different formats of water rights? Are there optimal combinations of water rights?
465 Third, what has been the impact of private sector or user participation in terms of water sector
466 performance? Fourth, is decentralization good or bad for water governance? Is it not the case that
467 the privatization of urban water utilities has failed and that irrigation management transfer has
468 produced mixed results? Fifth, what has been the poverty impact of water laws and policies in
469 developing countries? What can we learn from successful examples privatization on one hand
470 and significant improvement in of water service to the urban poor? Sixth, what lessons can be
471 learned from supposedly successful examples of integrated river basin management such as the
472 case of the Yellow River Basin Commission of China? Can these lessons be replicated in other
473 developing countries? Seventh, and finally, which of these governance solutions or bundle of
474 solutions provide the most cost effective means to significantly improve water sector

475 performance? Indeed, a rigorous answer to these questions may lead to a more conclusive
476 answer to how water governance really matters to improving water security in developing
477 countries.

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Dimension	ID	Component	Definition
Water Law	L1:	Legal Distinction of Different Water Sources (ORD)	This represents the degree to which varying water sources treated alike or differently by water laws (i.e., surface water, ground water). It is on a scale of 0 to 10, 10 being "Very Different", 0 being "Alike“
	L2:	Format of Surface Water Property Rights (NOM)	This indicates the basis of general rights in surface water. The scores center around the following criteria: none, not clear, common or state property, multiple rights, riparian system, appropriative system, correlative system (equal or proportional sharing) and license / permits
	L3:	Legal Accountability of Water Sector Officials (ORD)	This represents the effectiveness of accountability provisions by water laws for water officials. It is on a scale of 0 to 10, 10 being “Highly Accountable", 0 being “No Accountability“.
	L4:	Decentralization Tendency within Water Law (ORD)	This illustrates whether or not present laws contribute to centralization and the strength of the tendency of present laws towards centralization. It is on a scale of 0 to 10, 10 being "Highly Centralized", 0 being "Highly Decentralized“.
	L5:	Legal Scope for Private and User Participation (ORD)	This represents how favorable the legal provisions for private sector, nongovernmental organization (NGO) and community participation in water development/management are. It is on a scale of 0 to 10, 10 being "Very Favorable", 0 being "Unfavorable“.
	L6:	Legal Framework for Integrated Treatment of Water Sources (ORD)	This indicates the integration level of water laws with other laws on land, forest, and environment. It is on a scale of 0 to 10, 10 being "Highly Integrated", 0 being “Fragmented”
Water Policy	P1:	Project Selection Criteria (NOM)	This indicates the criteria used in water project selection and how extensively they are applied in irrigation, urban and multi-purpose projects. The scores center around the following criteria: no response, political dictates, equity factors, ecological factors (ECO), benefit-cost ratio (BC), internal rate of return (IRR), and multiple criteria
	P2:	Linkages with Other Policies (ORD)	This represents the extent of the influence of other policies on water policy. It is on a scale of 0 to 10, 10 being “Highly Influential", 0 being “No Influence“. The linked policies include agricultural policies, energy and power policies, soil conservation policies, pollution control and environmental policies, fiscal policies (structural adjustment), credit and investment policies, and foreign investment and aid policies.
	P3:	Pricing Policy (ORD)	This represents the extent of cost recovery by tariffs. It is on a scale of 0 to 10, 10 being "Full Cost Recovery", 0 being "Full Subsidy“. The average of domestic, industrial, and irrigation pricing policies is derived
	P4:	Private Sector Participation (ORD)	This corresponds how favorable water policy is on private sector participation. It is on a scale of 0 to 10, 10 being "Very Favorable”, 0 being "Unfavorable”. The scores are averaged across the domains of irrigation, urban domestic use, rural domestic use, and industrial and commercial use.
	P5:	User Participation (ORD)	This explains how favorable water policy is on user participation and decentralization. It is on a scale of 0 to 10, 10 being "Very”, 0 being "Unfavorable”. The scores are averaged across the domains of irrigation, urban domestic use, rural domestic use, and industrial and commercial use in the stages of planning & development and operation & maintenance.
	P6:	Linkage Between Water Law and Water Policy (ORD)	This represents the extent of the linkages between water law and water policy. It is on a scale of 0 to 10, 10 being “Tightly Linked", 0 being “No Linkage“.
	P7:	Attention to Poverty and Water (ORD)	This represents how well the concerns of the poor are reflected by water policy. It aggregates two components - the existence of such policies and their effectiveness and extent. It is on a scale of 0 to 10, 10 being “Highly reflected”, 0 being “Hardly reflected”
	P8:	Finance for water Investment (ORD)	This represents the adequacy of funding available for current and future water investments. It is on a scale of 0 to 10, 10 being "Highly Adequate", 0 being

			"Inadequate". The scores are averaged across the funding for "new Infrastructure", "utilities repair and O&M", "irrigation", and "water resources management".
Water Administration	A1:	Organizational Basis (NOM)	This shows the basis on which water administration is organized. The scores center around the following criteria: on administrative division (geographical basis), on hydro-geological regions, on river basins, and mixture of all.
	A2:	Functional Balance (ORD)	This indicates whether or not functional specialization within water administration is balanced. It is on a scale of 0 to 10, 10 being "Highly Balanced", 0 being highly "Unbalanced". The tested functions are -- Planning and design, Implementation , Financial management , Operation and maintenance, Rehabilitation and resettlement , Environmental monitoring , Research, training, and extension, Interagency or departmental relationships
	A3:	Existence of Independent Water Pricing Body or Apex Body (ORD)	This represents the existence of independent bodies for determining water price. It is on a scale of 0 to 10, 10 being "Existent", 0 being "Non-existent".
	A4:	Accountability and Regulatory Mechanisms (ORD)	This represents the effectiveness of the accountability arrangements evaluated. It is on a scale of 0 to 10, 10 being "Highly Effective", 0 being highly "Ineffective". The accountability mechanism was analyzed with respect to both within and outside of formal administration.
	A5:	Validity of Water Data for Planning (ORD)	This represents the adequacy and reliability of water data for planning purposes. It is on a scale of 0 to 10, 10 being "Highly Valid", 0 being "Invalid".
	A6:	Science and Technology Application (ORD)	This indicates the extent to which the following science and technology components are used within water administration: computers, remote sensing and satellite, research and experimental information, modern accounting and auditing techniques, management information systems, geographic information systems, wireless communication, water-measuring technology, computerized dynamic regulation of canals and water delivery networks. The aggregate score is on a scale of 0 to 10, 10 being "Very Extensive", 0 being "Very Low". The scores are averaged across the technologies specified above.

588 Table 1. Conceptual and operational indicators of water governance
589 Source: Adapted from *Saleth and Dinar* [2004]. (Note: ORD refers to Ordinal Variable; NOM is
590 a nominal variable)

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Region	Countries
South East & South Asia	Bangladesh (4, 2), Cambodia (1, 5), India (9, 3), Indonesia (4, 4), Lao PDR (1, 3), Nepal (2, 4), Pakistan (3, 3), Philippines (3, 5), Singapore (0, 3), Sri Lanka (3, 2), Thailand (1, 4), Vietnam (2, 4)
North East Asia	Japan (4, 1), Korea (1, 0), China - People's Republic of (5, 2), Mongolia (0, 1), Taipei-Taiwan (1, 0)
Central Asia	Uzbekistan (0, 3)
Oceania	Australia (6, 0), New Zealand (1, 0)

592 Table 2: Country Coverage and Survey Response Count: The first entry in the brackets next to
593 country names indicates the frequency of response in the 2001~02 survey and the second entry
594 indicates the same frequency in the 2009~10 survey.
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