# Conceptual Framework of South Asian Water Futures Exchange

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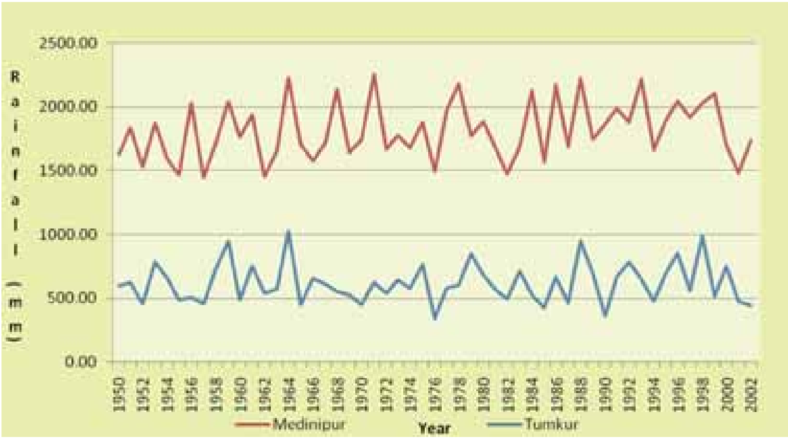
This article is about conceptualizing a futures market in water availability. The risk of water availability is a painful reality not only in Indian agriculture, but south Asian agriculture as a whole. Crop failure, more often than not, has been a function of drought conditions, than anything else. With south Asian agriculture being dependent on the timely occurrence of the monsoons, any deviation from the scheduled arrival of the monsoon causes problems not only for the farmers, but is also a threat to the food security of the region. Quite unfortunately, there is no market in south Asia where users and investors exposed to water availability risk can effectively hedge against such risk. This risk, undoubtedly, is becoming alarming as concerns of climate variability in the region are growing because a large part of south Asian agriculture is dependent on precipitation from the Southwest Monsoon (June to September). *Figure 1* reveals the pattern of precipitation during the Southwest Monsoon from 1950 to 2002 in two districts of India, namely, Medinipur district in West Bengal, and Tumkur district in Karnataka. Both the districts are located on two critical river basins of India (rather south Asia, as a whole): Medinipur is on the Ganga basin, while Tumkur is on the Cauvery basin.

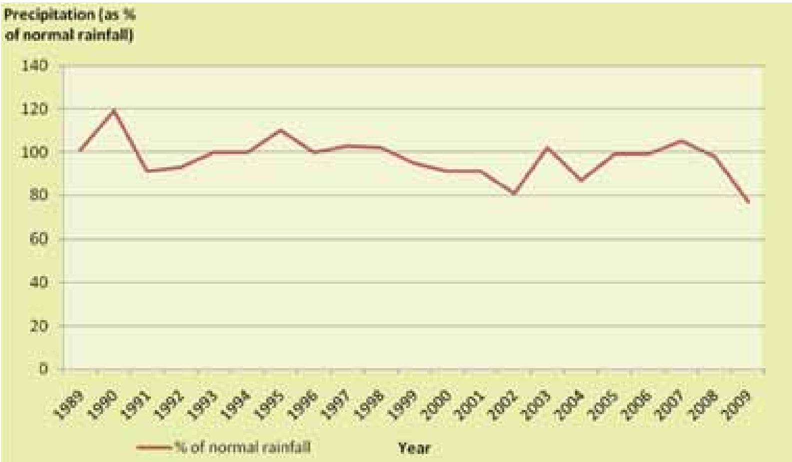
*Figure 1* shows the rainfall variation in the two districts. The

Figure 1. Precipitation during southwest mansoon in Medinipur and Tumkur districts (in mm)




*Source: www.indiawaterportal.org*

Figure 2. Precipitation in 35 districts in India during southwest monsoon (as % of normal rainfall)




*Source: Fertilizer Association of India* inconsistency in the precipitation pattern is quite perceptible here. What has become alarming is that the variability in precipitation has actually increased in recent years. When the period of analysis is divided into two phases, namely, 1950–1975 (Phase I) and 1976–2002 (Phase II), it has been found that in both the districts the standard deviation of precipitation during the Southwest Monsoon has increased in Phase II, thereby revealing an increased risk to water availability for rain-dependent agriculture (*Table 1*).

**Table 1.**
**Standard deviation of precipitation during southwest monsoon in two districts (mm)**

| | Tumkur | Medinipur |
|---|---|---|
| 1950–1975 | 147.85 | 188.18 |
| 1976–2002 | 170.73 | 214.44 |

**Source:** *Computed by the author from IMD data*

Fertiliser Association of India data for 35 select districts across India show that the precipitation in India over the last 21 years (1989 to 2009) has varied between 77% (in the worst case) to 119% (in the best case) of normal rainfall (defined by long-term average value) (*Figure 2*).

Interestingly, in the 10 years from 1989 to 1998 (*Figure 2*), rainfall has been normal or more than normal for eight years, except for 1991 and 1992. However, between 1999 and 2008, rainfall has been scanty, and for eight years the precipitation has been less than normal (with normal being defined as the long-term average by the Meteorological Department); only 2003 and 2007 had more than normal rainfall. Because of this erratic nature of the Southwest Monsoon, water availability risk has increased, thereby causing concerns of water conflicts in various basins in India, as also south Asia.[1]

Reservoirs often fail to obtain and release waters timely, which causes havoc for agriculture. An example of the Mettur Dam in Tamil Nadu in India is given in *Table 3*. Karnataka and Tamil Nadu are co-riparian states in India sharing the Cauvery waters, with Karnataka being the upstream state; the first barrage to receive waters from the Cauvery after the river crosses the Karnataka boundary is Mettur. As for a failed monsoon in the basin, Karnataka might fail to release the stipulated amount of water to Mettur Dam, as was warranted in an Interim Order of the Cauvery Water Tribunal in 1991. This often turned out to be the cause of graver inter-state water disputes.

**Table 2.**
**Percentage deviations from normal flow to the Mettur Dam in Tamil Nadu during Southwest Monsoon**

| Year | Deviation from normal flow to the Mettur in Southwest Monsoon*** | Crop failure/ Water dispute? |
|---|---|---|
| 1992-93 | 64.06 | – |
| 1993-94 | -20.73 | Yes. Crop failure in many Tamil Nadu districts. |
| 1994-95 | 65.06 | – |
| 1995-96 | -28.14 | Yes. Inadequate rainfall; Tamil Nadu moves to court. |
| 1996-97 | -26.27 | Yes. Inadequate rainfall; crop failure in Tamil Nadu districts. |
| 1997-98 | 1.72 | – |
| 1998-99 | -16.26 | Yes. Crop failure and Tamil Nadu moves to court. |
| 1999-00 | -26.83 | Crop failure in various districts in Tamil Nadu. |

*Source: Estimated by the author from dmc.kar.nic.in; Season and Crop Report, Dept. of Economics and Statistics, Govt. of Tamil Nadu, Chennai; Menon and Subramanian (2002); Ghosh and Bandyopadhyay (2009).*

Quite evidently, the existing risk of water in south Asian agriculture is a threat to food security and many other associated businesses of agriculture. Risk mitigation strategies, so far, have primarily been confined to supply-augmentation plans and demand-management mechanisms. It is difficult for supply-augmentation plans (like construction of big dams, water transfers, and river interlinking) to succeed as water has already been fully allocated, and further tampering with nature might even prove to be economically unviable and ecologically unsustainable.[2] Demand side management through adaptation mechanisms also needs innovation. More importantly, none of the current risk-mitigation strategies financially compensate in those instance where water is unavailable. Rather, there is a value loss due to unavailability of water, and the cost of adaptation (through shifting of crops, or construction of storages) is not less either! Informal water forward markets are in vogue to a certain extent in many parts of south Asia, though they have not been successful enough to mitigate the risk of water availability on a scale as that of the river basin.

Parties with exposure to water availability risk are not merely irrigators. Rather, to regard water availability risk as a risk borne only by irrigators fails to appreciate the fundamental nature of the risk to the entire economy. Investors and financial market participants have no desire, ability, or interest in acquiring physical water to offset that risk; neither do they have any incentive to take up the hedger's risk and take physical delivery of water.

Yet, lending institutions like banks might bear an inherent risk with water availability. A bank may lend money to a farmer to invest in planting a crop, and it faces an inherent risk when the crop fails due to no rain. An agricultural processor also faces the risk as unavailability of water will prevent him from getting the raw produce for processing. Even re-insurers do not have means to cover their exposure to a flood.[3] None of these parties have any incentive in trading of physical water rights because of two reasons. First, they cannot use the physical water once purchased. Second, physical water rights do not mitigate the risk associated with water availability.[4] There is no doubt that south Asia presently requires a different institution to hedge against this risk.

## Benefits of a Water Futures Market

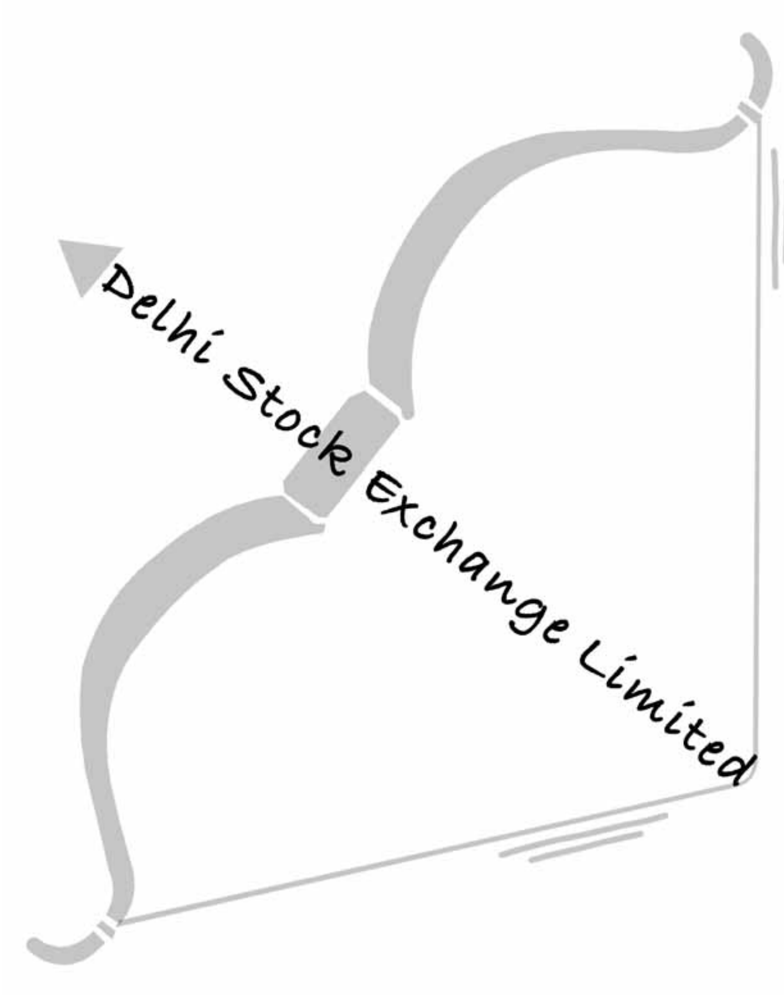
There are various expected benefits of the water futures markets (WFM). First, water futures market will help discover price (through the scarcity value of the resource), thereby leading to an efficient use of the resource. Thus, the market aids efficient allocation, helps proper distribution, and offers means of achieving social optimality in consumption and production. At the same time, social planners often take either consumption or production to optimize the net economic welfare of a system subject to some constraints, which might be in resource availability, infrastructural bottlenecks, economic identities, and so on. Social planners can look at the prices realized in such a futures market and can eventually formulate plans.

Second, water futures contracts will provide a price indicator for future stored water. This will assist investment decisions as also forward risk management.[5]

Third, the price realized at the futures market will be an objective instrument of decision-making for project prioritization. Often, when there is more than one project, a choice has to be made between them. The futures price, being formed through available information, will provide a quantified basis for ranking projects, and will eventually aid decision-making.

Fourth, pricing of natural resources can raise public and political awareness of the importance and availability of the resource. A high value of a natural resource might imply its high importance to the community. Where valuation mechanisms are absent, communities fail to realize this importance. The importance of carbon sequestration by wetlands is always better understood when expressed in monetary terms.[6] In the absence of a formal market for water in south Asia, there is no way in which scarcity values of water can be expressed in an institutional framework. A futures market, by discovering prices, will indicate the scarcity value of the resource based on future availability, and thereby create public, policy, and political awareness on how to manage an impending crisis.

Fifth, irrigated as also rain-dependent agriculture, dependent on the availability of water,

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will be able to use the market (or products derived from the market) to insure themselves against droughts by locking in prices in the water futures market. Such risk transfer in the private sector will significantly reduce the burden of drought relief currently borne by governments.

Sixth, water futures provide the financial tools required by investors and banks to confidently invest in the rural sector. This would result in long-term planning and investment that will actually deliver water to areas that need it rather than simply insure against its absence. In fact, banks and financial intermediaries can develop other products suitable for their customers by making use of the water futures market.[7] Seventh, a water futures market will help in promoting the best water-efficient technology. Since, the key element in market creation and development is information development and data processing/ mining and infrastructure, there will be more investment in information-gathering and decision-making tools for water. This will further stimulate research on water resources and will eventually help in the crisis management of the future.

Hence, there is no doubt that futures market has an important role to play in optimal decision-making and prioritization. The price discovered in the futures market, thus, can offer a mechanism for extending justice and setting conservation priorities within a limited budget.

As a result, the beneficiaries from a water futures exchange are many. On the one hand, the beneficiaries include the entire agricultural value chain starting from the farmer to the consumer. In case of a drought, a supply shock not only pauperizes the farmer, but price rise also creates a dent in the pocket of the consumer. Hedging in the water futures exchange will not only minimize the producer and the supplier's risk by creating adequate compensations for the loss, but will also put the suppliers in a position to pass on parts of the benefits to the consumers. On the other hand, drought conditions have often forced the governments to create further safety nets by further subsidizing the farmers. This has often placed unanticipated pressures on government exchequer, and forced governments to divert funds that otherwise could have been used for the development of rural infrastructure or other developmental activities. A futures market for water, however, will act as a market-based "bail-out institution" for all the beneficiaries, thereby reducing the pressure on the government exchequer.

In a similar vein, corporations producing hydropower may also benefit from the futures markets. Municipal corporations, municipalities and water boards can also do so by taking appropriate positions in the futures exchange for water and may use the funds for infrastructure development for betterment of urban services.

## The Structure of Water Futures Market

The water futures market may initially begin on a national scale in India where commodity futures markets are already in vogue. However, there are a few initial problems at this stage. This is concerning the Forward Contracts Regulation Act of 1952, which still dictates commodity futures trading in India and does not allow trading in invisibles or index futures. Essentially, when water futures are traded, they should be traded in indexes, rather than being traded physically. Physical delivery might not make sense here, and might even act as a deterrent to trading for two principal reasons. First, the cost of physical delivery might be so high (due to construction of infrastructure, movement costs, and so on) that it will clearly deter participation and inhibit liquidity in the market. Second, as stated earlier, a majority of the stakeholders (banks and other lending organizations) are not concerned with the physical availability of water, but more with value loss due to water scarcity. They are least interested in taking physical delivery of the resource, but more interested in locking in the value with which they are facing the risk. Hence, there is a crucial need for developing an index with which trading can take place, and the final settlements of trade need to be settled in cash.

The problem arises here. For such trading to take place in India, the Forward Contracts Regulation Act of 1952 needs to be adequately amended to incorporate index trading. On the other hand, banks and financial institutions should also be allowed to participate in the futures market. They are not only stakeholders in the water market, but they are needed to provide liquidity to the market. They will be the ones to take up the hedger's risk. Thus, these are the pre-conditions for the water futures market to be initiated in India. The next step then emerges in the development of indices to indicate water availability.

### *Developing the Water Availability Index*

The development of any market is based on the identification of the commodity or the index with which trading should take place. For water futures markets, it is important to develop the water availability index, which needs to be independently and objectively priced, with minimum scope for artificial manipulation. However, for India, it is important to develop a contract for each major river basin in a given state. For example, there might be two contracts based on two indices on the Cauvery basin—one for the water stored in the barrages or reservoirs within the borders of Karnataka, and one for the water stored in the barrages or reservoirs within the borders of Tamil Nadu. Despite being in one basin, water in each boundary has traditionally shown different scarcity values, as shown by Ghosh and Bandyopadhyay.[8] This is because the kind of risk faced by the farmers in Tamil Nadu, though contingent upon a few common broad climatic factors, is also dependent upon the hydropolitics of the region where the water availability is often a "zero-sum" game. The risk faced by downstream Tamil farmers is more, as upstream Karnataka might not release an adequate amount of water in the dry season, despite the existing statutes, rulings, and agreements. A common index for the Cauvery basin, as a whole, thus will not reflect the true situation. Hence, there is a need for different state-specific indexes for farmers and other stakeholders to hedge their risks.

As an example, let us consider *Table 3*, which shows the various barrages, their capacities, and the actual storage on a typical day of the 23rd week of 1998 in the Cauvery river basin in Karnataka. The four dams are Harangi, Hemavathy, Krishnarajasagara, and Kabini.

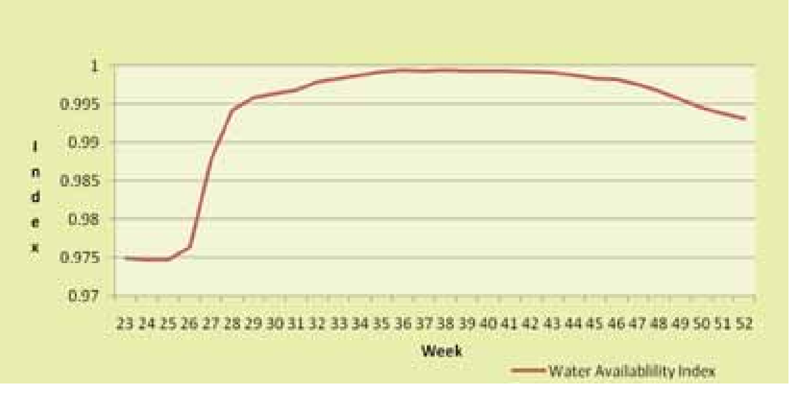
The index represents the actual storage in the node (consisting of the four barrages in this case) as a percentage of "full capacity." The index moves up and down in response to actual water stored in the four dams representing the node here. The maximum index value is 100, and the minimum index value is zero. As storage increases in response to water inflows, the respective index will also rise. In *Table 3*,

**Table 3. Dams in the Cauvery basin in Karnataka**

| Dam | Average Daily Storage on Week 23 1998 (feet) | Full Capacity | % of full |
|---|---|---|---|
| Harangi | 2790.65 | 2859 | 97.61 |
| Hemavathy | 2866.14 | 2922 | 98.09 |
| KRS | 73.53 | 124.8 | 58.92 |
| Kabini | 2254.39 | 2284 | 98.70 |
| **Total** | **7984.71** | **8189.8** | **97.50** |

*Source: Author's estimates from dmc.kar.nic.in*

**Figure 3. Water Availability Index**




*Source: Estimated by the author*

it is shown that the water availability index stands at 97.5 on week 23 of 1998. Since average daily data on a weekly basis could only be found in the public domain, all the estimations have been based on that.

Tracing the water availability index (WAI) between the 23rd week and 52nd week of 1998 (with average daily storage considered), the fluctuation looks like the one shown in *Figure 3*. Thus, it needs to be kept in mind that the Cauvery is essentially a rain-fed river, and hence, there should be a high correlation between rainfall and water flows into the dams.

**Figure 4. Scarcity value of water in Cauvery-Karnataka node for kharif rice (Rs/cu metre)**


*Source: Estimated by the author*

**Figure 5. Water availability index during kharif for Cauvery-Karnataka (1992-99)**

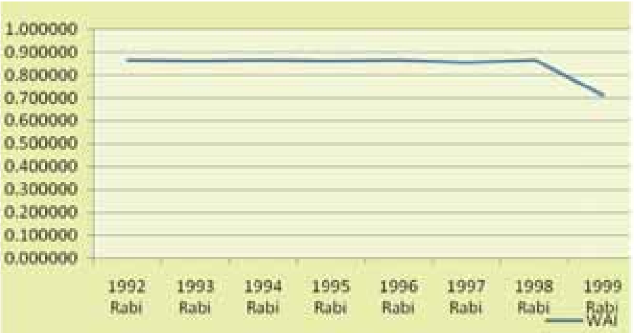

*Source: Estimated by the author*

### *To What Extent will such an Index Reflect the Scarcity Value of Water?*

This is a crucial question. Ghosh and Bandyopadhyay[9] estimated the scarcity value of water in the Cauvery basin over time and across seasons. In that paper, scarcity value was defined as loss of rice production per unit of water. This is because the aim of that paper was primarily to find a typical variable affecting water conflicts, and rice (paddy) was the principal crop grown in the Cauvery basin region, occupying a large portion of the area. Considering the broad estimates of Ghosh[10] and Ghosh and Bandyopadhyay[11] in the present paper, the WAI for two agricultural seasons (*kharif* and *rabi*) have been taken for the Cauvery-Karnataka node. Ghosh[12] and Ghosh and Bandyopadhyay[13] defined scarcity value by the value foregone due to water scarcity. In their theoretical framework, scarcity value in a water-scarce economy emerged out of surplus maximization, which is subject to the water constraint, and has been defined by the shadow value of water. This shadow value has been found to be equal to the difference of (value of) marginal product and marginal cost.

By multiplying the minimum support price for paddy with the scarcity value expressed in kg per cubic metre of water, the scarcity value has been expressed in rupees per cubic metre of

**Figure 6. WAI for rabi in Cauvery-Karnataka**




*Source: Estimated by the author*

**Figure 7. Scarcity value of water for rabi in Karnataka (Rs/cu m)**


*Source: Estimated by the author*

water. *Figure 4* and *Figure 5* show the average WAI and the average scarcity value of water for the *kharif* season from 1992 to 1999.

The movement of WAI for the *kharif* season for the Cauvery-Karnataka node is, of course, a function of the success or failure of the monsoons. This is clear from the fact that in 1995 and in 1998, rainfall in the Cauvery basin was less than normal, as documented by Ghosh,[14] and which resulted in lower WAI.

The scarcity value of water in the Cauvery-Karnataka node for *kharif* rice is increasing, thereby reflecting an increasing demand for water in the basin (*Figure 5*). An improvement of WAI is not always associated with a reduction in the scarcity value (SV) because more area has been brought under paddy cultivation (the most water-consuming crop in the region) during this phase. However, it is clear that in 1999 (a year of bad monsoon) a sharp decline in WAI has been associated with a sharp rise in scarcity value.

It needs to be remembered that *kharif* paddy is less dependent on irrigation as compared with other crops of rice. Hence, though a negative and significant correlation exists between WAI and SV for the *kharif* season (that is -0.65), the correlation coefficient is not as strong as being in the high range of -0.9 and above (*Table 4*), as will be witnessed for *rabi*.

**Table 4. Correlation coefficient of water availability index and scarcity value (*kharif*) in the Cauvery-Karnataka node**

| | WAI | SV |
|---|---|---|
| WAI | 1 | -0. 65** |
| SV | -0.65** | 1 |

*** Significant at 1% level.*

As can be deciphered from *Figure 6* and *Figure 7*, the relation between the two variables is stronger for *rabi* rice.

In fact, between 1992 and 1998, WAI had moved between 0.8 and 0.9, while SV had moved between Rs 0.4 per cubic metre and Rs 0.6 per cubic metre. However, a drop in WAI to around 0.71 in 1999 was associated with a sharp increase in the scarcity value to Rs 1.31 per cubic metre, thereby entailing a more than double increase in scarcity value.

The correlation coefficient between WAI and SV of water for *rabi* rice (*Table 5*) is as high as -0.92.

**Table 5. Correlation coefficient of water availability index and scarcity value (*rabi*) in Cauvery-Karnataka node**

| | WAI | SV |
|---|---|---|
| WAI | 1 | -0.92** |
| SV | -0.92** | 1 |

*** Significant at 1% level.*

Therefore, in both cases, the correlation coefficient is negative and significant at 1% level. However, the negative relation is stronger for *rabi* as compared with that of *kharif*. This is also expected. Paddy is a water-intensive crop and requires standing water. *Kharif* paddy is not essentially dependent on irrigation, as the growing season merges with the Southwest Monsoon. Hence, the correlation between the SV of water and the WAI (based on the water stored in reservoirs), despite being negative, is not really high. On the other hand, the *rabi* crop depends on irrigation, and hence a low WAI will result in a high scarcity value. This adequately matches with the theoretical explanation of scarcity value of water, as explained by Ghosh and Bandyopadhyay.[15]

While the prices in the markets in which such indexes will be traded are supposed to reflect the scarcity value of water, one may safely assume that the price-sensitivity of the water index (or the elasticity) will be high during dry periods, and primarily for irrigated crops.

The futures contract can be developed for various nodes of the various river basins in India, depending on the boundaries of the states lying in the basin, and locations of the reservoirs over the river basins. As an example, there might be two separate contracts for the Cauvery-Karnataka node, and the Cauvery-Tamil Nadu node, as the patterns of water availability risk in the two states over the same basin are different. For Krishna, Godavari, Ganges, Mahanadi, Sabarmati, and various other river basins or sub-basins, there is thus a need for different types of contracts, depending on the number of nodes (and which depends on the number of states through which the rivers flow). A more detailed note on the number of contracts for each basin will be presented in future research.

## Using Futures Market to Hedge Water Availability Risk

Let us consider a farmer in the drought-prone Birbhum district in West Bengal. In January 2010, the farmer plans to plant paddy in May 2010 on the expectation that there will be good rains during June to September 2010. However, he is concerned with the possible dry conditions that might make water unavailable for his paddy. He calculates that the loss from a failed crop will be Rs 1 lakh, while the profit from a successful crop will be Rs 5 lakh.

Assume that the current level (January 2010) of the WAI in that node of West Bengal over the Ganges is 70.2%; with August 2010 water futures contract trading at Rs 50 on the expectation that there will be good rain during Southwest Monsoon, the WAI will increase to around 85%. The farmer, therefore, decides to buy 200 August 2010 WAI Farakka node contracts (the water of the Ganges gets diverted to resuscitate the Kolkata port through the Farakka Barrage in West Bengal, which was constructed in 1975) at Rs 50. We ignore the existence of margin for the time being.

*Scenario A:* Drought prevails due to failure of the Southwest Monsoon, and the paddy crop fails. The WAI goes down to 50%, with its price increasing to Rs 100 during expiry. As the contract expires on a particular day in August, the farmer cash-settles his position and earns a profit of Rs {200 x (100-50)} = Rs 100,000, thereby recovering the loss incurred due to a failed monsoon.

*Scenario B:* If there are good monsoons and WAI crosses the 85% mark, the farmer earns a profit of Rs 500, 000 by selling his crop. On the other hand, because the WAI is also high, with its price declining to Rs 25, on the day of the expiry of the contract the farmer incurs a loss of Rs {200 x (50-25)} = Rs 50,000. But this loss gets adequately offset by his profit earned by selling his crop.

Though, this exposition takes up the case of a representative farmer, probably in the same manner, one may illustrate how other stakeholders like banks, development financial institutions, hydro-power producing units, institutions providing agricultural credit, and so on may hedge against the vagaries of water availability risk. Such hedging will, eventually, smoothen out profits and losses by minimizing the uncertainties in the outcomes. While apparently this mode of hedging is prevalent in commodities, hedging in water should be treated more as hedging in "inputs" rather than the hedging in "outputs."

## Extending the Frontiers of Futures Exchange Beyond National Boundaries

The water futures market, rather than being only national, should extend beyond national boundaries. This is because waters of south Asia cross national boundaries, and hence, there is a need for various participants from various nations to emerge in the futures market and trade. On the one hand, the waters of the Indus is being shared by India and Pakistan, while on the other hand, the Ganga-Brahmaputra-Meghna basin is shared by Nepal, India, Bhutan, Bangladesh, and China. Each of these nations faces the water threat, which is getting aggravated due to climate change. On the other hand, the respective national problems are also there. Hence, water scarcity leading to water politics is a two-level game in south Asia. Under such circumstances, there is a need for a trans-national exchange with an electronic trading platform.

The South Asian Association for Regional Cooperation (SAARC) was established for the promotion of regional cooperation. While the rivers connect several countries in the region, and thus, their cooperative management is very important for the development of a trans-national market, hydro-diplomacy over transboundary waters has not been on the agenda of SAARC seriously. In fact, the most recent water-related co-operations date back to 1996 when the India-Bangladesh Treaty on the sharing of the lean flow of the Ganges and the treaty between India and Nepal on projects on the Mahakali River were entered into. One of the oldest bilateral negotiations between India and Nepal on the river Kosi has been going on for several decades. Such negotiations now need to be rethought for developing a futures market, as conceived in this paper. In addition, such an agenda should include the opening up of hydro-diplomatic exchanges with China on the projects China plans to take up upstream of the Brahmaputra. In recent years, SAARC has achieved some quick progress on cooperation on developmental problems like trade and industry.

With advances in economics, serious thoughts need to be given to the development of institutions on the economic role of water for its consumptive use as well as for trade in south Asia.[16] The highly competent diplomatic core of south Asia will surely understand the arguments behind this paper. A review of the writings from Bangladesh and Nepal on various water-related treaties and agreements clearly bring out the feeling of suspicion and anger of the smaller countries. For Bangladesh, whether it is the older writings of Abbas[17] or the more recent ones of Mirza,[18] they all express a feeling of entering into an unequal treaty. On the other hand, a recent and comprehensive review of water relations between India and Nepal[19] reinforces such a feeling among senior Nepalese water professionals. For Indian hydro-diplomacy to be effective and not get bogged in narrow engineering projects, the approach to diplomacy needs to be inclusive, and needs to seriously think of frameworks like sub-basin (or state-specific) futures contracts for water resources.

In the trans-national water exchange for south Asia, the participants should ideally be from the various nations of south Asia. They may take their respective positions to hedge their water risk, and with adequate information about water flows, meteorology, topology, and so on the price at the various river nodes represented in the futures contract should reflect the SV. Quite alike the national level exchange, there will be various contracts traded on such an exchange depending on the number of nodes at the sub-national level. Hence, while the scale of operation increases in space (with more contracts traded), the modus operandi of a South Asian exchange can remain identical to that of a national level exchange.

## Concluding Remarks

This paper has presented an idea that might seem apparently capricious and hypothetical, but definitely not out of relevance. The initial idea undoubtedly involves setting up of a national exchange in India, which, as an economy, has proved its credentials in technology-driven commodity exchange trading. As rainfall and water availability becomes uncertain, and water-related conflicts intensify, a futures market for water seems to be the answer institutionally. However, a lot needs to be done for such an institution to be effective. The most crucial one is creating adequate infrastructure to bring about real-time flow data in the public forum. For most transboundary river basins in south Asia, water flow has remained *classified*, and hence out of the public domain. The reasons, of course, are political. This has deterred independent research on international river basins. It needs a concerted effort of the SAARC nations to think of cooperation for setting up a water exchange for the south Asian region and bring in classified data in the public forum. In this regard, institutions like South Asian Federation of Exchanges (SAFEX) can play an important role in coming up with important policy documents that can be placed in the SAARC summit for discussions.

The bureaucratic core of south Asia has to understand that at the core of hostile hydropolitics of the region lies the non-realization of the real value of water that has been lost in the mire of subsidization. Water conflicts have arisen as water has been treated almost as a free good, leading to reprehensible exploitation of the resource—mainly in agriculture.[20] It is the futures markets for water that can make the common man understand the real value of water by discovering prices.

This article has not really discussed the regulatory part of the exchange. Though initially one may think of trading water on a national commodity exchange in India under the fold of the Forward Markets Commission (for which amendment of the FCRA of 1952 will be required), yet, over time, it has to be placed under a separate dedicated regulatory authority specializing in water trading. Even at the trans-national level, a trans-disciplinary knowledge base for water resource economics, institutions, and hydrological engineering has to be created, and the regulatory authority's expertise should not only be confined to the working of the markets, but should extend to an understanding of the trans-disciplinary knowledge base, as well as regulatory problems. The regulatory authority should adequately consist of specialists in various aspects of water resource management, rather than merely having bureaucrats, and should have their regional offices in various capital cities of south Asia.

However, in the development of a water exchange, it is important to place sufficient information on all water-related aspects in the public domain, as also develop adequate analytical methods and instruments for better prediction. With knowledge based on adequate information, an efficient futures market for water can help in discovering the price of water, which will reflect upon the scarcity value of the resource. On the expiry of the contract, with cash settlement taking place rather than physical delivery of the resource (unless a hedge has been rolled over), the cash-settled price will reflect the SV of water. This will ensure liquidity of the contract and help resolve water-related conflicts. Therefore, to sum up, one may state that from the policy perspective, there are two advantages of setting up a water futures exchange in south Asia. First is the social dimension of reducing social cost of water conflicts. Second is the creation of wealth from the markets, thereby ensuring regional development.

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NOTES

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