Commodity Derivatives and Risk Management
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Lecture 59
Water Derivatives

Welcome to the 59th lecture on Commodity Derivatives and Risk Management. And today we are going to discuss various aspects of water trading as well as water derivatives. Please note that water is becoming a very scarce commodity and hence many exchanges have started offering derivative contracts on water as the underlying. In this context let us understand how water trading happens and how water derivatives can be utilized to mitigate the risk associated with increase in water prices. In this context let us first understand our the let us let us first understand water as a commodity. Please note that 2.5 percent of the planet's water supply is only fresh water, the rest 97.5 percent of the water is saline water which is not usable for human consumption. And in this context please also note that the total fresh water used in the past century grew twice as first as the world population. So, if the world population has grown let us say 100 percent of our freshwater use has increased by 200 percent. And I am sure all of us can understand this concept very clearly because every time we are flushing the water, we normally use 8 to 9 liters of water. So, on average if a person is flushing the toilet 3 to 4 times a day. So, on average we are spending about 35 to 40 liters of water on a daily basis just merely flushing the toilets. And on top of that the cost of the water does not reflect the true economic value, hence we waste a lot of water. Basically, when we are buying a bottle of water, we are only paying 10 rupees, that 10 rupees itself does not really reflect the cost of the water or the true economic value of the water. And most of us also pay very little amount as a water bill for our domestic consumption. Hence, because we do not pay a substantial amount of money for buying water, we waste a lot of water. And in this context please note that the water shortage is becoming an extremely important requirement for important issues for human consumption, not only for human consumption, but also for farming and livestock rearing. So, farmers all over the world face acute water shortage and also companies which are into livestock rearing also face significant amount of water shortage. In this context Australia has done a considerable amount of effort in creating a market for trading surface water rights or water entitlements. Let me repeat that Australia has vast land of arid regions and very sporadic rain happens in most part of Australia. Hence Australia put significant amount of effort in creating a market where the surface waters, freshwater rights or water entitlements can be traded. Now let us go ahead and understand what exactly has been done in the Australia and how water can be traded. Please note that Australia has as I mentioned has vast land

of arid regions and in about 60 percent of the available fresh water goes into the agriculture and livestock farming in Australia. And the trading in the water happens in regional markets based on a local catchment area or bodies. For example, let us say in a particular location or a region there are some 3, 4 water the bodies reverse. So, all businesses which are depending on that water for their normal day-to-day business activities will be given water rights or water entitlement and these people will be able to trade among themselves the water entitlement or the water rights. As I mentioned, a farmer or livestock rearing company is given water rights or entitlement from the local area. So, there are many regional markets in Australia, as of now there are 6 to 7 different regional markets where the trading of water rights or water entitlement is happening. Now let us go and understand how exactly this water entitlement or water titles are allocated and how the subsequent trading happens. Now coming to the water trading at a regional market, one of the very well-known water trading markets is the Murray-Darling Basin. So, as you can see this is the image which I have taken from the official website that will be the details related to the image source is mentioned here. And the Darling River is here, and you have a Murray River here and you have a Murray-Darling River Basin and lot of companies Agri companies as well as your livestock farming companies operate here and they are given water rights or water entitlements and this is the eastern part of Australia you can see cities like Melbourne, Canberra, Sydney, Brisbane etcetera. Now coming to the water rights or water entitlement the there are two types of rights which are traded in the Murray-Darling Basin, and these are water entitlements and water allocation. So, what exactly is the difference between water entitlement and water allocation? Please note that water entitlement is the total amount of water one owns over a long period of time. So, this water entitlement is allocated to a particular company, a livestock farming company or an Agri business company over a long period of time and that allocation is done by the civic authority. In this case Murray-Darling Basin authority this particular authority is empowered by the Australian government to allocate water entitlement and water allocation. Water entitlements are the long duration entitlement where one particular company has been assigned some amount of water which one can use from the river and other catchment area over a long period of time. Unlike water allotments you have water allocations which are the percentage of water entitlement one can draw from the water source in that year. So, every year the local the authority Murray-Darling Basin authority also allocates the short-term water allocation to this member to this companies. So, for every one-year water allocation is done and over a long period of time the water entitlement is done and please note that the water allocation amount is a subset of the water entitlement amount. And every year allocation is done for a water year in Australia water year is treated from 1st July to 31st June. And this water entitlements or allocation is done by the state appointed authorities based on the area plantation or area of livestock farm done by a company. So, if a farmer has a larger area of Agri farming or livestock farming then that particular farmer or that particular

company will be allocated larger amount of water entitlement and water allocation. And please also note that if the land is sold, the water entitlement also gets transferred to the buyer of the land. So, not only does the ownership of the land gets transferred to the buyer the water entitlement and water allocation rights also goes to the buyer. And the actual usage of the water for every member having water rights is major through the water meter. So, how much of water, one buyer is able to withdraw from the common river or common catchment area that is major through a water meter. All these initiatives all these regulatory measures are under the Murray-Darling Basin Authority. And now coming to how exactly the water trading happens. So, in the case of water trading, one seller sells once water allocation which is a temporary one-year allocation amount or entitlement which is a permanent allocation to another eligible water license holder. Please note that the buying and selling can happen for actual members who will be holding the water license. No bank or no financial institution or no speculator can be part of this particular exercise as of now. So, if a seller intends to sell its water allocation or water entitlement right, it can do so only to another eligible water license holder. In this case let us understand how exactly the water trading happens through trading platform. This image on the right-side panel indicates the actual buying and selling online through an online portal where the actual buying and selling of water rights or water entitlement happens. From this particular screenshot I have just taken a small sample, a small portion which exactly indicates the different aspects of the trading. And please note that this trading is done by buy and sell order matching buyers who are interested in buying water rights or entitle entitlements they will be giving their buy order with the price at which they would like to buy. Similarly, the sellers give the sale order the extent of water they would like to sell and the price at which they will be selling. And please note that this order matching is exactly the same manner as we buy and sell shares in the secondary market. So, there is a limit order book I am sure those of you have demat account and you buy and sell shares you will be able to very easily recognize this particular screen. As you can see on the left side there are orders given by the buyers. So, the first column shows the quantity of water which is expressed in gigalitres and the price at which they will be selling that is also mentioned. And similarly, the buyers would also be mentioning the quantity as well as the price. And please note that the order matching the interest of buyers and sellers is matched based on the principle called the best buy order matches with the best sale order. So, what is the best buy order? Best buy order is always from the sellers' point of view. So, if at any given point in time let us say there are 10 sellers available, all these 10 sellers will identify one buyer as the best buyer who is giving the highest price. So, when we are talking about the best buy order that is among the list of buyers whoever is giving the highest price order that particular party will be known as the best buy order. Similarly, the best sale order is going to be the party which is offering the lowest price among all sellers. So, as you can see, the orders will be arranged in a best buy order and orders will also be arranged in the form of a best sale order. So, as you can

see the best sale order in this case the 85 dollars, which is dollar per million liters. So, 85 dollars is the lowest price offered among all other sellers. So, that is why this particular party has the highest priority. Coming to the left panel as you can see 94 dollar is the highest price given by them among all buyers. Hence this particular party has been given the highest priority and best buy order and best sale order will be executed first. Now, coming to the spot as well as forward trading as you can see somebody can enter into a spot contract through this online portal and also somebody can enter into a forward contract where both buyers and seller negotiate the price today and the right to withdraw the water from the water body will be transferred from the seller to the buyer, it will be transferred today, but the seller the buyer will be able to withdraw the water at a later point in time typical example of a forward contract. So, the buyer of the forward contract will be able to buy the underlying, in this case the water right or water at a later point in time. Now, let us understand who will enter into a forward contract or why anybody will be interested to enter into a forward contract. Let us say a farmer is fearing a very dry spell and is anticipating that the next year there is going to be reduced water allocation by the authority and which is leading which may lead to the higher price for temporary transfer. So, the fear of a particular farmer is that next year is going to be, let us say drier year with less rainfall and that less rainfall is going to lead to a lesser water allocation. Please note that the water allocation is done on a year-on-year basis and that the fear of the farmer that next year is going to be lesser water allocation will do by the authority. And if the particular farmer does not enter into the contract today and it wants to buy water at a later point in time it may have to pay a high price. Please note that for some water the water entitlement and permanent water allocation is given free. So, every farmer will be getting some amount of free water, over and above if somebody wants to use that then they have to pay a price and buy that water entitlement or water allocation from somebody else. So, in that context the money comes into please do not think that every single gallon of water or liter of water a particular farmer is using they have to pay money for it. The answer is no, they only pay for it if they want to buy or utilize water more than what they have been allocated in that context the price comes into the picture. So, the farmer is fearing drier spell in the next year and reduced water allocation and standing today this particular farmer will be entering into a long forward contract with the counterparty and all this transaction will happen in the online trading platform both parties will be giving quantity as well as price and if the order matching happens the order will be executed. And if the dry season spell really continues then this farmer will be able to withdraw the water. However, if the farmers anticipation was wrong and there was enough rain and water allocation was good enough next year water allocation was sufficient enough for it to run its own business then this particular water right the forward contract may not be of much use. Now, coming to the counterparty, let us say the counterparty who has taken a short forward position to the farmer that particular party probably was anticipating that next year is going to be good monsoon and they are going

to get a good amount of water allocation through the normal process. Hence, this particular party has gone ahead and sold its existing rights. If really rain happens then this particular party will be benefiting that it has already got the money, but if really rain does not happen then it has to go ahead and buy water right from somebody else at a later point in time to fulfill the requirement. At that point in time the short forward position may be paying a higher amount of money to buy water rights. So, a farmer or a livestock owner company who has the water right have to be really careful in entering into a forward contract and that may benefit them or that may harm them depending upon what is going to be the actual rainfall in the next year. Now, coming to another Basin which is known as a Goulburn Basin the previous examples which I was giving that was for the Murray-Darling Basin. In Australia there are another regional market which is known as the Goulburn Basin. In this gold bond Basin also exactly, the same thing happens water entitlement and water rights are given to companies and Agri firms and depending on their requirement they do buy and sell of water rights. And this particular table shows the actual number of trades which have happened in the in the rain year 2022 to 2023 basically starting from July 2022 to June 2023. And this detail which I have downloaded from the gold bond Basin website the detail related to the data is mentioned here in the data source. And as you can see the number of trades how many times buyers and sellers have entered into a contract, that number of trades is very clearly mentioned, and the volume of water traded which is about giga liter. So, 1 giga liter is about 1000 million liters. So, 1000 million liters is equivalent to the 1 giga liter. So, a different time of the year or different month of the year ah during that year different amount of water has been traded as you can see the month of March and May which be the drier months or summer months in Australia, the quantum of water traded has gone up very high as well as the price at which water trading also has happened that is also high. So, ah March May and you have also in this context you have also a March May and September March May been the months where the largest amount of water has been traded and at a different prices or median price hovers around 4500 to 9000 Australian dollar and other details are also mentioned here. Now, please note that at times their buyers and sellers those who are related party let us say to ah to farmers who have some kind of a common relationship maybe to farmer groups they may be come from the from the same company or some kind of a relationship they have an intra business relationship. So, they at times transact this particular water right at zero cost. So, that is the reason why zero is coming here. As mentioned here transactions between related parties are otherwise non-monetary terms are zero and zero priced as part of the transfer pricing. Like Murray Basin as I mentioned gold bond Basin is another geographical area location with within the Australia and the above table relates to the water trading detail for the year 2012 to 2013. So, this also indicate that how the water trading spot trading of water is a very involved and very detailed activity in Australia. And to best of my knowledge as except USA and Australia no other country has started water trading in a such a formalized or organized manner.

Now, coming to the ah next aspect which is water trading in California. Please note that the state of California USA experiences periodic spells of drought. For example, during the 5-year period 2012 to 2016 California experienced a major water shortage. In other times of the year, in other periods such as 2007 to 09, 1987 to 92, 1976 to 77 California has experienced significant amount of water shortage leading to drought. And thus, what I am going to explain now exactly similarly the same concept is ah applicable in case of Australia. So, whatever the way Australian civic authority grants certain water entitlement or water rights to business houses exactly the same thing is done in the California market. So, the civic authorities and municipality bodies in different cities and Agricultural farm sectors are given water rights. Please note that in case of Australia there are many civic authorities and municipalities also who are involved in supplying drinking water to ah households. So, they are also the part of they are also part of this particular initiative, and they also get the water rights, and they get the water rights in different regional markets. Please note that California also has different catchment areas and different rivers. So, for all regional market water rights are given to the parties who are in who need water from that particular catchment area. And water rights entitle the owner to divert or pump water from the river or streams or groundwater Basins. And in the USA water trading happens in a denomination which is known as the US dollar per acre foot. And an acre foot of the water which is very simple to understand acre foot of water equals to about 3,26,000 gallons of water or enough water to cover an acre of the land which about 1 foot deep. And based on the actual trading of the water the NASDAQ exchange prepares an index which is known as your NASDAQ Veles California water index or popularly it is known as NQH20. So, this particular index is calculated and reported by NASDAQ and this index tracks the spot rate of the price of water rights traded in the state of California. So, the NASDAQ collects the rate at which buyers and sellers are transacting the water rights and from that spot rate it creates an index. And this index came into existence on October 31, 2018, with a value of 306.56 dollars per acre foot. The detailed methodology related to the collection of the index is available in this PDF file. I have given the link to this website so you will be able to understand more on the finer nuances associated with the calculation of this particular index. Now, coming to ah some facts related, or some details related to this particular index. Again, this snapshot of the image I have directly taken from the NASDAQ website as you can see this particular image shows the percent of California land area which experience extreme drought or exceptional drought. And as you can see, any year time of the any year when majority part of the California experiences a drought or extreme drought or exceptional drought you can see the ah index value that is the water index value NASDAQ veils California water index value going up. So, that goes on to prove that with the ah whenever there is a shortage of water a lot of trading happens, and the price of the water rights increases thus leading to the increase in NQH2O value. Now, this table I have this first panel I have downloaded from the data I have downloaded from the Bloomberg

website, and I have plotted the data related to the same index as you can see, since the beginning it has almost gone up the index has gone up exponentially however, from 2013 onward 2023, middle of 2022 onwards this index has shown some ah decline. And coming to the seasonality I did a seasonality analysis with respect to the data as you can see the month of July, August and September the data the index value has significantly higher as compared to the other months and the lowest months are January, February and which is much cooler months so, obviously, the demand for water goes down. So, the summer months in California range from May to October, hence this period coincides with the higher index value. In this context, please note that ah there is a futures contract available at CME Chicago Mercantile Exchange. So, a party who is fearing that the water prices are going to go up that particular party can enter into the futures contract, can take long futures contract on the underlying index. The lower panel indicates the NASDAQ market NASDAQ Veles California water index futures contract specification and as you can see the contract unit is 10-acre feet ah into the NASDAQ vales ah NASDAQ vales California index ah data and price quotation. So, somebody who is buying or selling the futures contract that particular party has to give a price quotation as if buying 1 acre foot of in US dollars and the contract maturity can go into quarterly contracts of March, June, September and December and this contract is always financially settled of course, nobody can deliver the index. So, depending upon the actual value of the NASDAQ vales California water index long and short futures position holders financial position will be settled and if a particular party really was fearing that there is going to dry going to be dryer spell and the index value is going to go up and if really the dry spell happens then this particular long futures position holder will be receiving money from the futures contract. With this we will end our discussion on all things related to water and water derivatives. Please note that all over the world only two country that is Australia and USA that that is California, USA, there is an active water market and derivative contracts, and derivative contracts and water also has started trading. However, my fear or my feeling is that the way we are experiencing water stress in India and many other parts of the world trading of water as well as derivative contracts in water trading is going to be a very common fact and not only be limited to countries like Australia and California. With this I will end the today's session on water and water derivative and in the next session we will be discussing more on another interesting derivative contract that is real estate index as well as the next session is going to be our last session ah on ah this set of lectures series, we will also discuss some interesting aspects related to major derivative losses faced by different companies. With this I will be ending today's session.