

## **Evaluation of the financial impact of electricity subsidy on the returns of tubewell owners and water buyers under declining watertables in Balochistan, Pakistan**

Syed M Khair<sup>a1</sup>, Richard J Culas<sup>b</sup>, and Shahbaz Mushtaq<sup>c</sup>

<sup>a</sup> School of Environmental Sciences, Charles Sturt University  
Wagga Wagga, NSW 2678, Australia. Email: [skhair@csu.edu.au](mailto:skhair@csu.edu.au)

<sup>b</sup> School of Agricultural and Wine Sciences, Charles Sturt University  
Orange, NSW 2800, Australia. E-mail: [rculas@csu.edu.au](mailto:rculas@csu.edu.au)

<sup>c</sup> Australian Centre for Sustainable Catchments, University of Southern Queensland  
Toowoomba, Queensland 4350, Australia. Email: [shahbaz.mushtaq@usq.edu.au](mailto:shahbaz.mushtaq@usq.edu.au)

**Abstract:** This study examines the financial impacts of electricity subsidy on tubewell owners and water buyers, and proposes alternative subsidy policy options that could balance the efficiency and equity. The results suggest that the subsidy plays a key role in stabilising production by providing financial incentives to tubewell owners to stabilise extraction cost under the declining watertables. The removal of subsidy will have considerable financial implications on tubewell owners, as well as water buyers. Considering the equity concerns and possible social and political turmoil, in the short run the study proposes that subsidy on electricity may be reduced to 50% to avoid social unrest and political repercussions. However, in the long run, to achieve efficiency and sustainability, the study suggests: (i) adoption of more appropriate cropping patterns suitable with local climatic conditions; (ii) adoption of most suitable and highly efficient irrigation techniques and technology; (iii) improved long-term ground water security through groundwater recharge via construction of dams; and (iv) strengthening of water markets system and institutional infrastructure.

---

<sup>1</sup> Mr. Syed M Khair. School of Environmental Sciences, Charles Sturt University, Locked Bag 588, Wagga Wagga, NSW 2678, Australia. Tel.: +61 2 6933 4746; Email: [Skhair@csu.edu.au](mailto:Skhair@csu.edu.au)

**Key words:** Financial impact, electricity, subsidy, returns, watertable

## **1. Introduction**

Subsidies for agricultural inputs have been part of a poverty alleviation programme in many developing countries (Badiani and Jessoe, 2011; Gullati, 1989). Inputs subsidies contributes to consumer welfare and real income through lowering food prices provided that a strong emphasis is put on a wider pro-poor dynamic growth objectives, complementary investment and output market development polices (Dorward, 2009).

There is sufficient evidence suggest that subsidies have shown greater effect on the development of tubewell irrigation because of the reduced cost of groundwater extraction. The growth in tubewell irrigation in turn increased crop yields, lowered food prices and benefited landless farmers (Briscoe and Malik 2006, cited by Badiani and Jessoe, 2011).

In India the benefits of flat rate subsidized electricity supply to agricultural tubewells are not restricted to tubewell owners only but also extended to tubewell non-owners who are mainly small farmers through groundwater markets (Shah, 1993). The number of people who get affected by subsidy polices is much greater than tubewell owners (Shah, 1993). In India, electricity subsidies are enabling farmers to use electricity for groundwater pumping at a price below the marginal cost of supply which help reduce their cost of pumping (Badiani and Jessoe, 2011). Evidence from case studies from Asia (India and Sri Lanka) and Africa (Malawi) suggest that subsidies on agricultural inputs such as fertilizer, electricity etc. have had a short to medium term impact on promising inputs use, raising farm output and thus reducing poverty (Wiggins and Brooks, 2010).

Subsidized electricity to agricultural tubewells was introduced in Pakistan to encourage farmers for groundwater use for increasing agriculture production (Ahmad, 2005). Pakistan has

paid Rs 1 trillion in energy subsidies over a four years period; this means that the government is providing electricity to the consumers at a lower price than its cost (GoP, 2011). Similar to many other parts of developing countries, electricity supply to agricultural tubewells is highly subsidized by the federal and provincial government in Balochistan province of Pakistan. Subsidy amounted to Rs. 6 billion in 2011 for around 16000 tubewells in Balochistan province only (GoP, 2011).

From a political economic perspective the government subsidy policy for agricultural tubewells has been criticized for its financial implications, equity concerns and the groundwater depletion. The complete withdrawal or at least its downward revision is proposed. Subsidy on electricity is also criticized for lacking equity by benefiting only around 8-10 % of farms out of approximately 200,000 farms in the Balochistan province (Ahmad, 2006a). He further argued that to improve equitable distribution of subsidy and reduce poverty, the existing subsidy may be directed for the improvement of water and energy resources, the benefits could be transferred to a much larger segment of rural farming communities. Therefore, it was felt necessary to undertake a study to see the effect of subsidy reduction on the returns of farmers especially under falling watertables and increasing extraction costs and highlight qualitatively the efficiency and equity gains and losses.

## **2. Tubewell irrigation in Balochistan in comparison to other provinces of Pakistan**

Table 1 shows the sources of irrigation and percentage area irrigated by each source of irrigation. Balochistan is highly dependent on tubewell irrigation as compare to other provinces. In Balochistan, the coverage of canal irrigation is limited to only its two districts out of 29, the remaining 26 districts depends on groundwater obtained mainly through tubewells and dugwells.

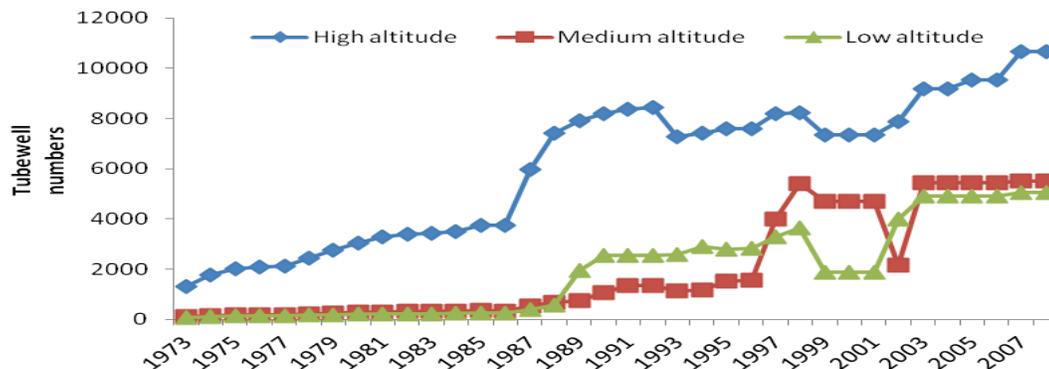
**Table 1: Sources of irrigation in Pakistan**

Province	Total area (million hectare)	Tubewell irrigated area (%)	Canal + tubewell irrigated area (%)	Canal irrigated area (%)	Other (wells, Kareze, Spring)
Punjab	14.53	20.44	54.03	24.91	0.62
Sindh	2.20	10.00	-----	90.00	-----
KPK	0.95	11.58	-----	81.05	7.37
Balochistan	1.16	35.34	3.45	54.31	6.9

Source: GOP, 2009

### 3. Existing groundwater situation and tubewell subsidy in Balochistan, Pakistan

As a result of the subsidy policy for many years the number of electric tubewells has been increasing with a rapid rate as compare to diesel tube wells, especially after 2001 when the power subsidy rate was raised to around 90 percent. The ratio of electric to diesel tube wells that was 0.47 in 1971 increased to 1 in 1982 due to rural electrification, it further increased to 1.81 in 2007 due to progressive increases in the subsidy rate. The Government’s policy of subsidy for power has therefore encouraged tubewell installation and hence increased pressure on groundwater resources (Figure 1).

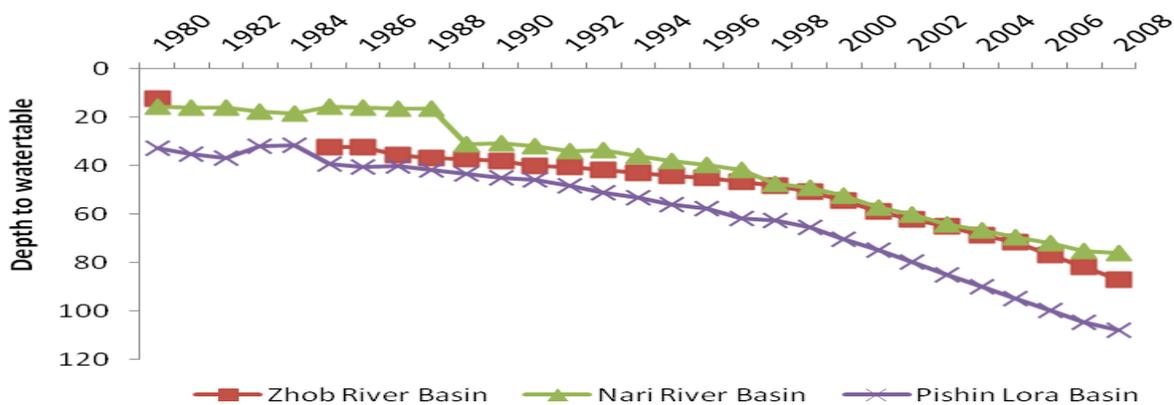


**Figure 1: Tubewell growth in upland Balochistan**

(Source: Agriculture Statistics of Balochistan, 1970-2008)

Ahmad (2006a) identified the following as the weakness of the government's current subsidy policy in Balochistan: First, farmers are not billed in terms of size of motor used and the duration of running of the tubewells. Second, because the farmers pay just 9-10 % of total bill they are less concerned about the efficient water use. Third, farmer's complaint about the less reliable and low quality electricity supply which include long power breaks, and voltage fluctuations which are blamed for loss of their electric motors, and causes excessive operation & maintenance costs.

According to chief engineer Quetta Electric Supply Corporation (QESCO), there are about some 3511 to 7000 illegal electric tubewells running in the province causing electricity overload and resulting in the power breaks of electricity. Currently some 15666 tubewell owners are getting subsidy on power bills in the province. [www.jang.com.pk](http://www.jang.com.pk). The current policy of subsidy is more likely to continue in future due to the socio-political situation of the province and the pressure on the groundwater resources are likely to be more intensified.



**Figure 2: Average decline in watertable (meter/yr) in upland Balochistan**

(Source: Survey, 2009; GoB, 1997)

A water balance study by Halcrow and Cameos (2007) shows severe water deficit occurring during the past 14 years, in the above three basins annual recharge are as follows: Pishin Lora Basin (mainly high altitude areas) with a deficit of 396 million cubic meters, Zhob River Basin (mainly medium altitude areas) with a deficit of 110 million cubic meters, while the Nari River Basin (mainly low altitude areas) with a surplus of 90 million cubic meters (Figure 2). With the current rate of groundwater extraction it is feared that these basins would be left with no water for future extraction (Ahmad, 2007a).

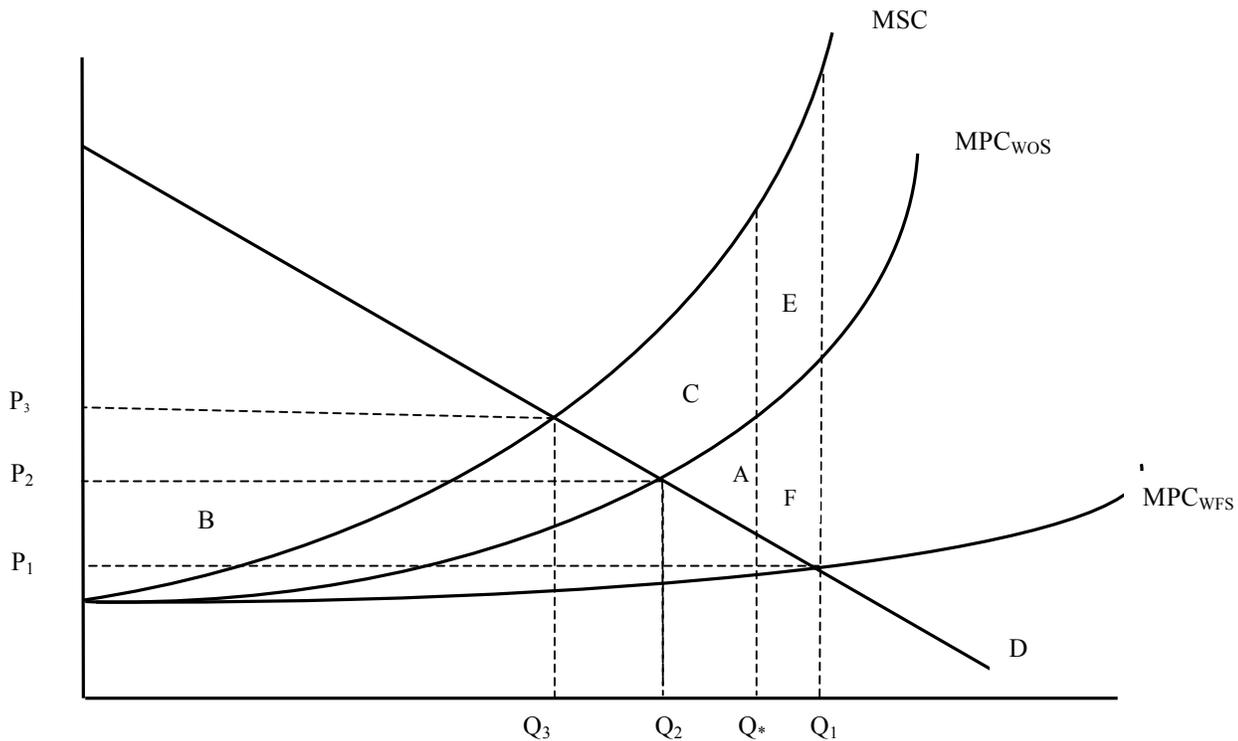
Groundwater is being mined in Balochistan (IUCN, 2000; Ahmad, 2007b) and in some of the sub-basins of the province watertables are declining at the rate 2 to 5 meters annually (Halcrow, 2008). Similarly, Qureshi 2009 reported a watertable decline of 2 to 3 meters. While Nasrullah, et al., (2012) in a recent study reported a more worse situation of watertable decline ranging from 1 meter to 6 meters in Pishin area of upland Balochistan. The survey 2009 results showed an average watertable decline of 4, 3.61 and 5.19 meters during the last ten years respectively at low medium and high altitudes of upland Balochistan (Figure 2).

#### **4. Theoretical framework**

The current trend of ever-increasing water demand can be changed through polices to increase water use efficiency. The most important way to induce water efficiency is through appropriate water pricing measures (Harris, 2006). Prices can be used to measure economic scarcity, environmental externalities and reflect physical limits (Harris, 2006). The subsidy policies caused inefficient and wasteful water use. Setting water prices closer to real cost of its supply would encourage farmers to shift to more efficient irrigation methods.

Figure 3 shows how the electricity subsidy policy of government for electric agricultural tubewells affects water prices, its supply and demand for farmers. Where D is the total water demand and MC is the Marginal Cost of water supply. The MSC curve is representing the Marginal Social Cost; takes into account the social cost related to damage to ecosystem and/or depletion of aquifers. P is water price and farmer is the price taker.

The electricity supply with 90% subsidy payment equal to area A & F caused the higher groundwater extraction at the water price  $P_1$  with extraction quantity of  $Q_1$ . At the  $Q_1$  equity gains are achieved but at the cost of efficiency losses. As shown by Figure 3, at the 90% subsidy level (assumed 24 hours electricity supply per day) the price of water is at low level i.e.,  $P_1$  is equal to  $MPC_{WFS}$ , this leads to demand of water with quantity  $Q_1$ . The price  $P_1$  is much below the equilibrium price  $P_3$  where  $MSC = D$ , and the zero subsidy equilibrium price  $P_2$  where  $MSC_{WOS} = D$ .



### Figure 3: Effects of subsidized water pricing

The low water price  $P_1$ , leads to competition among current irrigators to extract as much water as possible; and also is an incentive for more people to get in the industry and exploit the groundwater. This in turn creates the problems of over extraction from aquifers (water mining), because the quantity demanded (withdrawal) exceeds the quantity supplied (recharge). Besides this, there are also significant external or user costs associated with this excess water abstraction as shown by the area C & E and payment of subsidy equal to area A and F.

In such set of circumstance, to reduce efficiency losses, some sort of government intervention in the form of downward revision of the subsidy policy i.e., reduction of electricity subsidy to 50% to check the water resource depletion and reduce financial burden. Likewise, the subsidy is not completely removed to avoid the possible equity losses that may have happened in case of complete removal of subsidy. As part of this policy (the downward revision of the electricity subsidy from 90 to 50%) the equilibrium quantity of water withdrawal comes to the lower level of  $Q_*$ . This output leads to reduction of user or external costs equal to area E and avoiding subsidy payment equal to area F.

For more efficiency gains, if the subsidy is completely removed to zero, the marginal costs curve MPC will move upward and would lead further decrease in the user or external costs equal to area C and avoiding subsidy payment equal to area A. The new equilibrium would be at  $MSC_{WOS} = D$  and price  $P_2$ .

But in the short run, this policy of complete removal of subsidy will cause substantial equity losses by making groundwater pumping much costlier and its use for irrigation almost not feasible mainly for small farmers as shown by the gross margin analysis of different crops.

However, in the long run, this equilibrium can be achieved by improved water use efficiency through water demand management measures such as high efficiency irrigation systems.

Farmers may be converted to low water demanding crops) and supply management measures such as increase in groundwater recharge through construction of dams, strengthening of water markets, etc.

Similarly, if the full social costs are to be included (pricing the negative externalities involve with water extraction), the price would rise to  $P_3$  and quantity extracted would fall to the lowest level  $Q_3$ . At this point, output level would lead to a net social benefit of area would be equal to area B and avoid any external costs and subsidy payment. This pricing policy for price at  $P_3$  would promote economic efficiency as well as internalization of environmental costs (user costs imposed on future generations). But this policy may increase equity issues in such a way that the higher electricity price leads to increase in the water prices and cost of irrigation to both tubewell owners and water buyers. The small and landless farmers would be among the worst hit by this policy. Moreover, in practice, the political pressures will make it difficult to happen. Hence the following can be suggested:

To improve efficiency and at the same time remain equity gains, some sort of government intervention in the form of reduction of subsidy will set quantity  $Q^*$  at price  $P^*$  that ensures equity gains and also improve efficiency.

The important highlights of the above model may be summarized as under:

- For social benefits equal to area B, water demand D should be = MSC
- To get efficiency gain equal to area C & E, MSC should be  $> MPC_{WOS}$
- To get efficiency gains equal to C, E, A & F, MSC should be  $> MPC_{WOS}$  &  $MPC_{WFS}$

- To balance both equity and efficiency gains the subsidy equal to area F may be given to get output level  $Q^*$ .
- $Q_1$  at 90% subsidy ensures equity,  $Q_2$  at 0% subsidy ensures efficiency,  $Q_3$  at 0% subsidy for sustainability, while  $Q^*$  for balancing equity and efficiency with 50% subsidy

## 5. Methodology

Both primary and secondary data sources were used. A questionnaire based survey was also carried out in five purposively selected districts namely Pishin, Killa-Abdullah, Killa-Sifullah, Loralai, and Ziarat, of the low, medium, and high altitudes of upland Balochistan. Multistage area sampling method was used for the selection of districts, union councils, villages, and farmers. A sample of 230 tube well owners was selected randomly and interviewed.

### 5.1 Estimation strategy

#### 5.1.1 Estimation of gross margins and net returns of tubewell owners and non owners

Gross margins and net returns from different crops were computed using the following equation. Estimation of Gross margins (GM) was done using the gross margins approach using the following formula:

$$\text{Gross margin (GM)} = \text{Total Revenue (TR)} - \text{Total Variable Costs (TVC)} \quad (\text{i})$$

Where,

$$TR = (P_a \times Y) + (P_b \times Z) \quad (\text{ii})$$

$P_a$  = price of main product, and  $Y$  = quantity of output,  $P_b$  = price of by-product,

$Z$  = by-product quantity

And

$$TVC = \sum_{i=1}^n P_{xi} \times X_i \quad (\text{iii})$$

$X_i$  = quantity of input  $X_i$  for  $i=1, \dots, n$ ,  $P_{X_i}$  = price of input  $x_i$  for  $i=1, \dots, n$ .

The subsidized electricity affects the cost of irrigation, therefore, irrigation costs were computed assuming different subsidy rates, i.e., at the existing 90% subsidy level and the assumed subsidy levels of 50% and 0%. These irrigation costs for different subsidy rates were incorporated into the total cost of production of different crops produced at various locations of the study area.

### 5.1.2 Computation of Net Present Value (NPV) of gross margins from different crops over 10 years

To see the effect increasing extraction costs on the returns from different crops to tubewell owners and water buyers over an extended period of time, the Net Present Values (NPV) of gross margins were estimated using Microsoft excel. Because the expenditure involved and profits obtained spread over a number of years, the flow of future costs and returns are also important. The equation for finding the present value of an investment is as under:

$$NPV = \sum_{j=1}^n GM \times \frac{1}{(1+r)^t}$$

Where,

GM is the value of gross margin from an crop  $j = 1, \dots, n$ ,  $t = 1, \dots, k$  is the period of time in years and  $r$  is the interest rate = 12%, the interest rate in Pakistan (SBP, 2011).

### 5.1.3 Measuring the increasing groundwater extraction costs over time

The declining watertables are adding to the costs of extraction. While estimating/predicting the future returns to farmers, it is very essential to account for the increasing costs of groundwater extraction over time. The deepening watertables involve many costs which obviously affect the returns of the tubewell owner and water buyers. The present analysis was undertaken for an assumed deepening watertable i.e., further down by 5 meters on

average over a ten years period (as a worse case that has been observed in the region); the corresponding cost increase were accounted for all the locations of the study area i.e., low, medium and high altitude areas. It was reported during the survey that deepening tubewell beyond a certain level in different areas is very difficult due to hard rock occurrence. Similarly, in some areas deepening tubewell doesn't mean the existence of more water, but in most of cases water only exists at a certain depth after which groundwater vanishes.

The following methodology was adapted while estimating the increasing groundwater extraction costs of tubewell owner and water buyer:

(i). the incremental extraction costs are assumed to incur while chasing the deepening watertables. These costs were calculated by valuing the relevant items. These involve additional costs to tubewell owners are as shown as Table 2.

**Table 2: Tubewell extraction costs that vary with declining watertables 2009 (PKR.)**

Item	Low altitude	Medium altitude	High altitude
Delivery pipe	420.61	412.42	366.04
Electric cable	87.84	86.30	83.56
Pump/Turbine	110.00	110.00	80.00
Total cost per meter/tubewell	618.45	608.72	529.60
Cost per meter/acre	34	38	83

Source: Survey, 2009

ii. It is assumed that tubewell owner will transfer the effect of increasing extraction costs as high water prices to water buyers. It was also assumed that watertables will fall at the rate of 5 meters annually based on scientific evidence in the region as presented above and the survey 2009 results as presented in section 2.

iii. It is also assumed that the farmer will only go for an alternative tubewell somewhere else if the existing tubewell fails. Under such worse scenario, the installation of a replacement tubewell is assumed to take place on another place; in that case the costs would be two to three folds of existing costs and is not included in this analysis.

iv. The net available water is decreasing and the area is remote therefore, due to lack of required hydrological data about the amount of groundwater abstraction for agriculture purposes from the specified aquifers, lack of data on the environmental effects of tubewells, and lack of historical data about groundwater abstraction due to subsidy, the modelling was not done; instead the future extraction costs are predicted using the current and past extraction cost (Table 2).

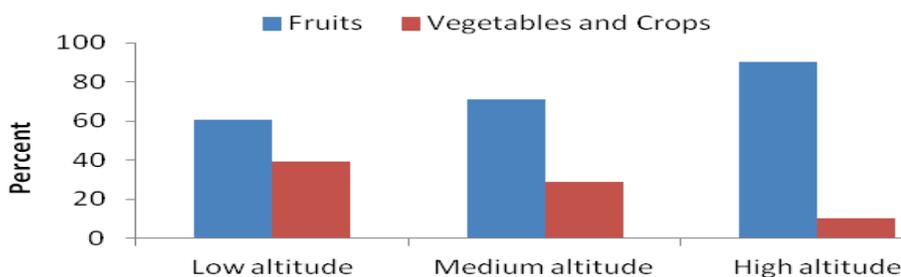
#### **5.1.4 Scenario analysis**

Many scenarios were developed to quantify the financial impact of different assumed reduced electricity subsidy rates with increasing extraction costs. The rationale for the scenario analysis is to examine the potential effects of subsidy minimization or its complete removal on the tubewell owners and water buyer's gross margins for different crop crops in short run and long run.

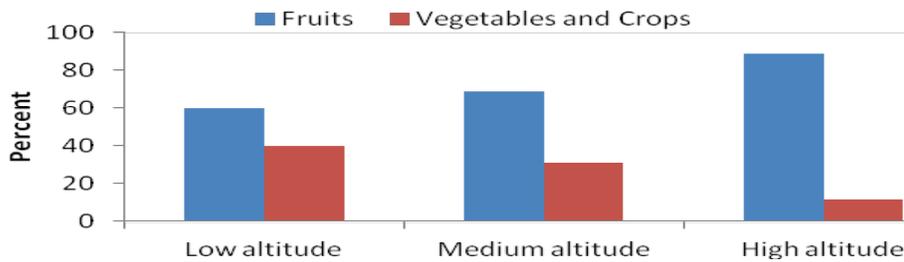
Scenario analysis was undertaken for tubewell owners and water buyers at the current 90% subsidy rate and an assumed 50% and 0% rates to find out its effect on the following parameters: (i) the gross margins from different crops raised on tubewells; (ii) the whole farm level implications on farmer's overall returns ; (iii) the effect of increasing groundwater extraction costs on the sum of NPVs of gross margins over a period of ten years 2010 to 2019, and; (iv) the combine effect of subsidy and increasing extraction costs on the sum of NPVs of gross margins 2010 to 2019.

## 6. Importance of fruits, vegetables and crops in the cropping pattern

Fruits are the high value crop in uplands of Balochistan. The fruit cultivation varies at different altitudes of uplands. As shown by Figure 4, fruits are grown on around 87 % of area in high upland area, followed by medium uplands with around 70 % area and low uplands with around 60 % area (GoB, 2009). Among other fruits, apple is the major one and high uplands being more suitable for the cultivation of high value varieties of apple. Apple is grown on some 85 %, 47 % and 41 % areas at high, medium and low altitude areas respectively. Similarly, the proportion of apple to the total incomes of farmers was found highest in the high altitude areas 80% followed by medium 70% and low altitudes 62% (Figure 5). On the other hand, the medium and low altitudes farmers get a sizable proportion of incomes from other fruits such as apricot and grapes and crops and vegetables. The proportion of fruits increased while that of vegetables and crops drops in the overall cropped area when we move up from low altitude areas to high altitude areas, while the opposite happen when we move down from high to low altitude areas due to more potential of growing high value fruits over there and vice versa (Figure 4).



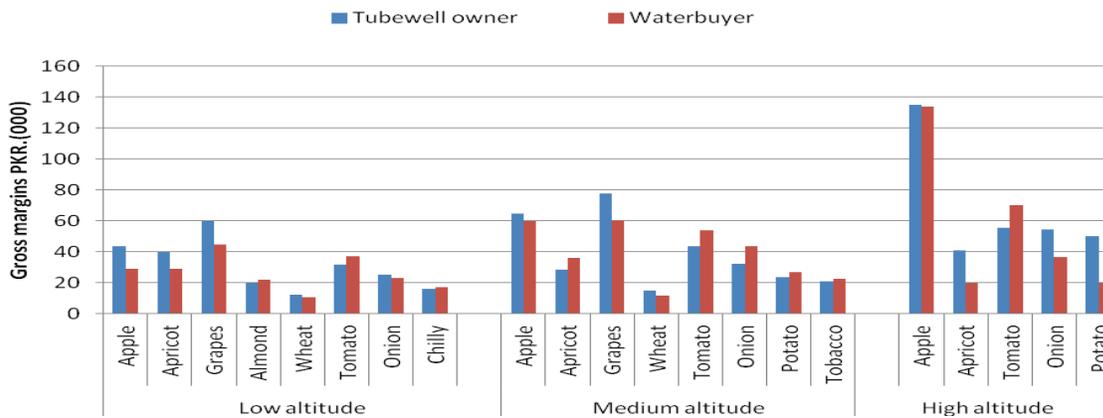
**Figure 4: Share of fruits in total farm area**



**Figure 5: Share of fruits in total farm income**

**7. Gross margins of tubewell owners and water buyers from different crops (per acre)**

As show by Figure 6, apple gives the highest return per acre in the high altitudes areas, while grapes gives the highest returns in the medium and low altitude areas. High altitude areas are also showing promising returns for crops such as tomato, potato and onion probably due to their climatic suitability for potatoes cultivation and late maturity advantage for onion and tomatoes that help get better prices in the market.



**Figure 6: Gross margins of tubewell owner and water buyers from different crops**

A glance at the gross margins of tubewell owners and water buyers shows that in general, tubewell owners are getting higher returns than tubewell non-owners probably due to their

ownership and control over water resources as a tubewell owner. While in few crops such as tomato at all locations, water buyer is getting higher returns than tubewell owners. This is most likely due to the specialization of tenant water buyers in tomato growing.

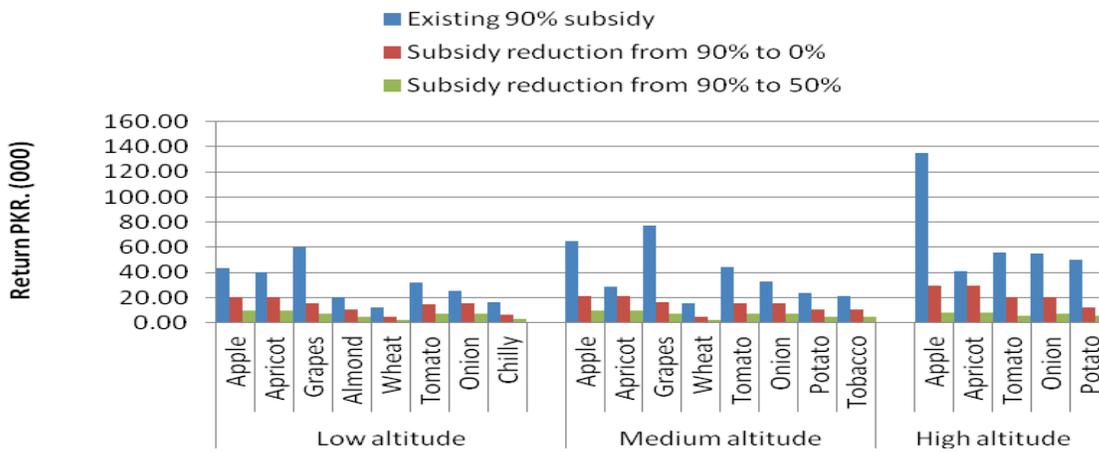
The significant gross margins drawn by both tubewell owners and water buyers are due to subsidized electricity that is directly related to the irrigation cost that covers the significant part of production costs of different fruits, vegetables and crops. For tubewell owner the irrigation cost constitutes about 15-29% of variable production cost at low altitudes, 13-38% at medium altitudes and 14-32% at high altitude areas. While for water buyer that cost constitutes about 15-35% at low altitude areas, 19-52% at medium altitude areas and 28-69% at high altitude areas. Complete removal or minimization of subsidy will increase the crops production costs manifold as analysed and presented in the following section.

#### **7.1 Scenario I- The effect of an assumed downward revision of subsidy from the existing subsidy rate of 90% to 50% and from 90 to 0% on the gross margins of tubewell owners and water buyers (per acre).**

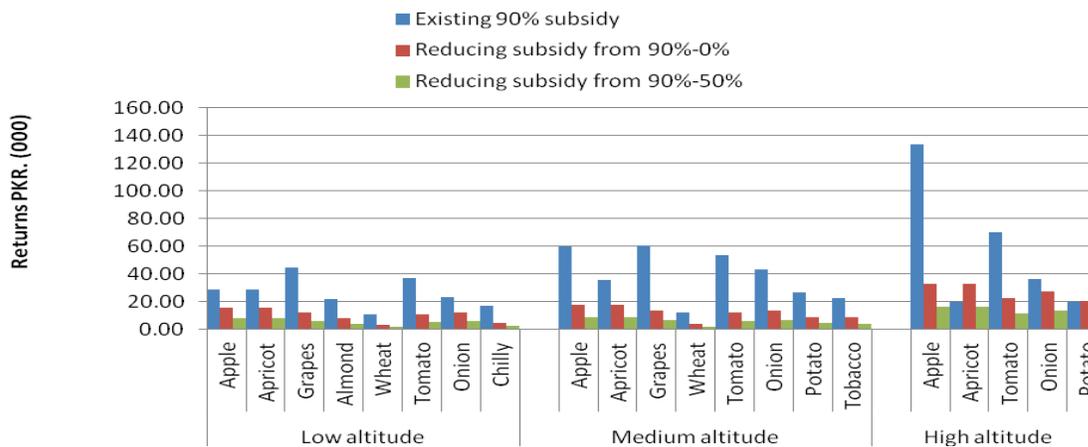
The scenario I analysis results showed that the reduction of subsidy from 90% to 50% will reduce the overall average gross margins of tubewell owners of low, medium and high altitude by PKR 16000, 20000, and 22000 respectively, and that of water buyers of low, medium and high by PKR 6000, 8000, and 15000 respectively. The effect of subsidy reduction intensifies as we move down to low altitudes because of low crop returns at low altitudes than in medium and high altitudes as shown by Figures 7 & 8.

The results showed that the reduction of subsidy from the existing 90% to 50% will cause an increase in the crop production costs and consequent decline of gross margins for all crops, except grapes, at the low and medium altitudes and apple and potato at high altitudes.

The complete withdrawal of subsidy from 90% to 0% will affect the overall average gross margins of tubewell owners of low, medium and high altitude by PKR 25000, 31000, and 41000 respectively and that of water buyers of low, medium and high altitude by PKR 12000, 16000, and 30000 respectively. The results showed that the complete withdrawal of subsidy will bear enormous effects on the returns of low, medium and high altitude tubewell owners and will make farming non feasible for all crops except grapes in low and medium altitudes and apple in high altitude areas. It is worth mentioning that the actual effect on the returns of tubewell owners would be more than what is estimated above because the fixed production costs of tubewell owners have not been accounted for.



**Figure 7: Loss of tubewell owner’s gross margins due to subsidy reduction for different crops**

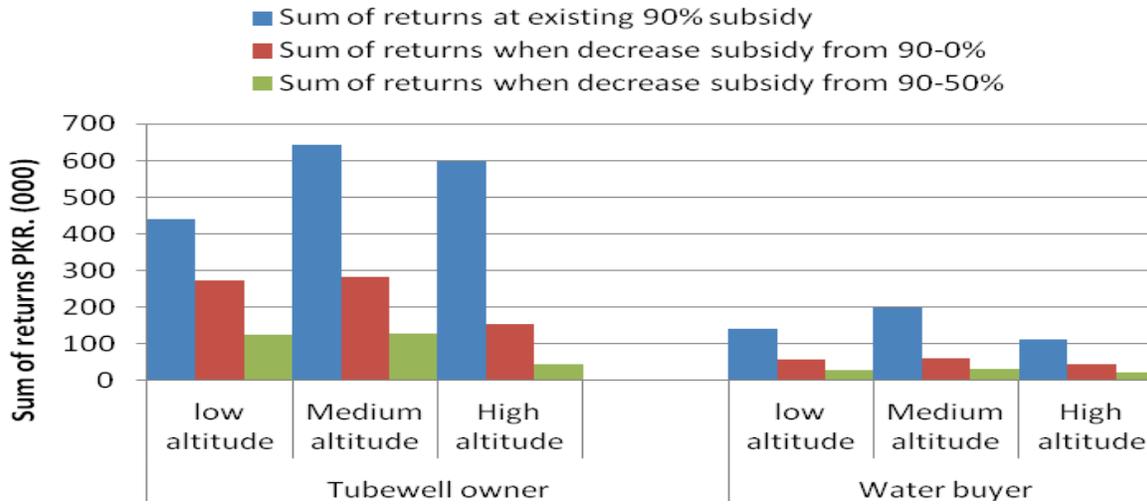


**Figure 8: Loss of water buyer’s gross margins due to subsidy reduction for different crops**

**7.2 Scenario II- Farm level implications of subsidy withdrawal on the sum of gross margins (per farm)**

The calculations are based on the percentage of crop areas at cropping patterns prevalent on the farms. The analysis shows that the subsidy reduction from the existing 90% to 50% level reduces the overall gross margin (taking all crops together) of tubewell owners at low medium and high altitudes by PKR 126000, 127000, and 44000 respectively, and water buyers at low, medium and high altitudes by PKR 28000, 30000, and 22000 respectively (Figure 9).

While the complete withdrawal of subsidy from 90% to 0% reduces the overall farm level gross margin of tubewell owners at low medium and high altitudes by PKR 272000, 282000 and 155000 respectively, and water buyers at low medium and high altitudes by PKR 56000, 61000, and 43000 respectively at low medium and high altitudes respectively. Tubewell owners and water buyers of low altitudes are to be worse hit by such move, followed by medium and high altitude area farmers. While the analysis shows that high altitudes farmers are not affected as worse as farmers of medium and low altitudes because of their highest per unit returns as shown by Figure 9.



**Figure 9: Loss of gross margins due to subsidy removal/minimization at farm level implications**

The complete withdrawal of subsidy has proved to detrimentally affect the profits of both tubewell owners and water buyers. Besides subsidy, the increasing groundwater extraction costs due to declining watertables; are also increasing the production costs and hence reducing the returns from different crop. They are also important to be taken into account. The following section presents the effect of increasing extraction costs on the gross margins.

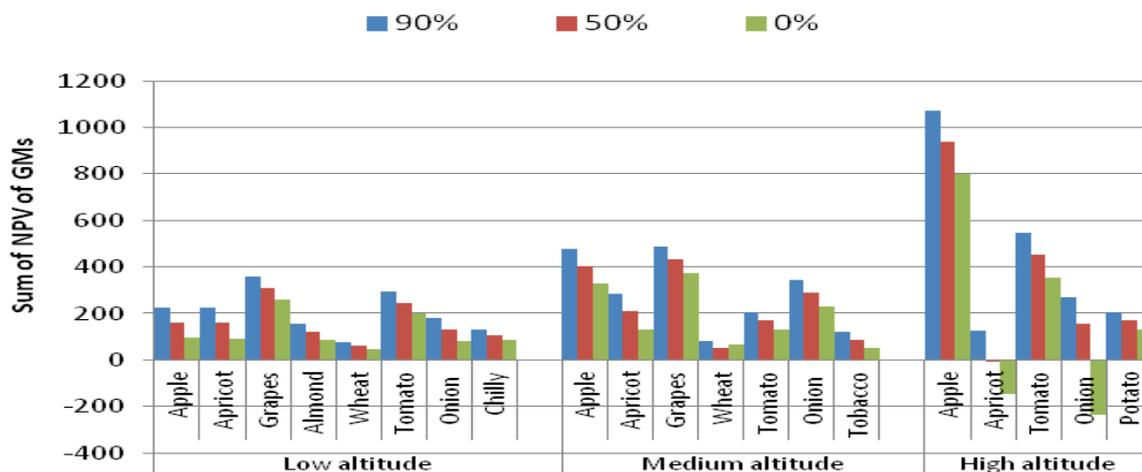
**7.3 Scenario III: The effect of increasing extraction costs (watertables assumed to fall down by an average 5 meters from the existing levels over the next 10 years) on tubewell owners and water buyers sum of NPV of gross margins at the existing 90 % subsidy rates (PKR/acre)**

To see what options farmers could have in future with increasing extraction costs due to declining watertables, the scenario III analysis was done. According to the results, the highest per acre effect of increasing extraction costs on tubewell owners and water buyers was reported in the high altitudes followed by medium and low altitude areas respectively. The future ten years analysis showed that with increasing extraction costs due to declining watertables, the tubewell owner’s sum of NPV of returns will reduce by about PKR 12000 to 19000, PKR. 6000 to 28000, and PKR 31000 in a ten years period at low, medium and high altitude areas

respectively. Similarly, water buyer's sum of NPV of returns will decline by PKR15000, 17000 to 18000 and 37000 to 38000 in ten years period at low, medium and high altitudes respectively. It is clear from the results that with the existing subsidy policy, the effect of increasing extraction costs on the sum of NPV of gross margins is small (5-10%) of total returns over a ten years period. However, any downward revision of subsidy are assumed to have greater consequences on the extraction costs because of requirement of high power electric motors to extract water from greater depths as shown by proceeding scenario IV analysis.

**7.4 Scenario IV: Examining the combine effect of change in subsidy rate and increasing extraction costs on the NPV of returns of different crops over a period of time (per acre)**

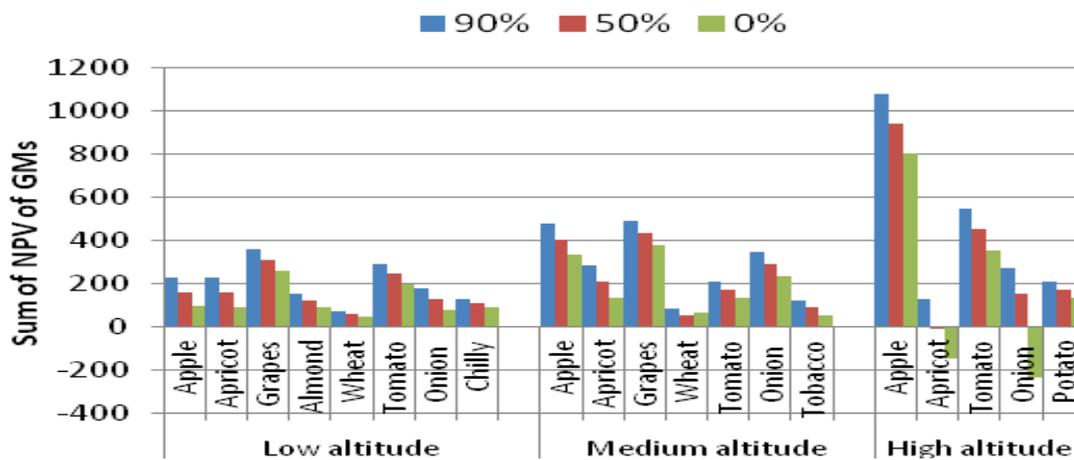
To see what options farmers could have in future with the combine effect of increasing extraction costs and a subsidy reduction to 50% and 0%, scenario IV was analysed. The results showed that the average sum of NPV of gross margins of both tubewell owners and water buyers diminished both in absolute and percentage terms.



**Figure 10: Tubewell owner NPV of gross margins at various subsidy rates and increasing water extraction costs (000) PKR /acre**

The reduction in tubewell owner's sum of NPV ranges from PKR 17000 to 80000, 17000 to 149000, and 48000 to 67000 at low, medium and high altitude areas respectively for different crops. Similarly, water buyer's reduction in the sum of NPV of returns will range from PKR 14000 to 67000, 31000 to 75000 and 95000 to 137000 at low medium and high altitudes respectively.

While the reduction in gross margins due to complete withdrawal of subsidy to 0% the reduction in the sum of NPV of gross margin of tubewell owners at low medium and high altitudes for different crops will range from PKR 37000 to 172000, 38000 to 212000 and 170000 to 242000 and that of water buyers at low medium and high altitudes respectively will range from PKR 28000 to 133000, 15000 to 149000, and 191000 to 272000. The crop wise analysis shows that a subsidy reduction to 50% caused more than 30% to 50% reduction in the NPV of sum of gross margins for all crops except grapes in low and medium altitude areas and apple in high altitude areas. While a further reduction of subsidy to 0% further narrowed down the returns by > 50% and except grapes in low and medium altitude areas and apple in high altitude areas made all types of crops growing almost non-worthwhile.



**Figure 11: Water buyer NPV of gross margins at various subsidy rates and increasing water extraction costs (000) PKR /acre**

The results presented as Figure 10 and Figure 11 shows that any downward revision or complete withdrawal of subsidy has great financial implications on the returns of tubewell owners and water buyers. Reduction in gross margins of any proportion means the same proportion increase in variable costs or decrease in total revenue. The tubewell owners are more vulnerable to any downward change in subsidy than water buyers, as gross margins do not cover their fixed costs of production. The water buyers on the other hand are dependent on tubewell owners, if they run out of business, then water buyers will have nothing to do.

**8. Conclusion**

The preceding analysis results show that the government subsidy to agricultural tubewells is functioning as a lubricant that keeps moving the wheels of tubewell driven agricultural economy of upland Balochistan. The subsidy benefits are not restricted only to tubewell owners as often claimed, rather are redistributed by groundwater markets to water buyers and many others who are many times more in numbers than tubewell owners. The results show that the subsidy reduction by more than 50 % or its complete removal under the present declining watertables (increasing cost of extraction) will make the existing agriculture farming on tubewell irrigation economically non-profitable for most of the crops at all three locations of the study area in general and at low and medium altitudes in particular. As a consequence, majority of existing farmers (mostly small and medium farm sized) will more likely go out of business in the short run, or will have to adopt a suitable and low water demanding cropping pattern with efficient water use in the long run. In turn, the result of subsidy removal may be a more likely increase in unemployment, social unrest and poverty in the area. So, keeping in view the socio-

economic and socio-political situation of the area, the immediate removal of subsidy to agricultural tubewells doesn't seem to be a viable option, however, it can be reduced to 50%.

## References

Ahmad, S. (2007a), 'Building High Performance Knowledge Institution for Planning of Water Resources in Balochistan'. *Water for Balochistan Policy Briefings*. 3(4). TA-4560 (PAK) Project for "Supporting Implementation of IWRM Policy in Balochistan - Government of Balochistan (GoB) - ADB and Royal Government of Netherlands.

Ahmad, S. (2007b), 'Karez- a Current Heritage of Natural and Agricultural Sectors and an Interminable System of Harvesting Groundwater in Balochsitan'. *Water for Balochistan Policy Briefings*. 3(14). TA-4560 (PAK) Project for "Supporting Implementation of IWRM Policy in Balochistan - Government of Balochistan (GoB) - ADB and Royal Government of Netherlands.

Ahmad, S. (2006a), 'Issues Restricting Capping of Tube well Subsidy and Strategy for Introducing the Smart Subsidy in Balochistan'. *Water for Balochistan Policy Briefings*. 2(1). TA-4560 (PAK) Project for "Supporting Implementation of IWRM Policy in Balochistan – Government of Balochistan - ADB and Royal Government of Netherlands.

Ahmad, S. (2006b), 'Payment of Electric Bills and Recovery of Arrears in Balochistan-Farmers' Response and Future Options. *Water for Balochistan Policy Briefings*. 2(2). TA-4560 (PAK) Project for "Supporting Implementation of IWRM Policy in Balochistan – Government of Balochistan - ADB and Royal Government of Netherlands.

Ahmad, S. (2005), 'Irrigation and Energy Nexus-Managing Energy and Water Use for Reducing Subsidy on Electric Tubewells in Balochsitan'. *Water for Balochistan Policy Briefings*. 1(1). TA 4560 (PAK) Project for "Supporting Implementation of IWRM Policy in Balochistan – Government of Balochistan - ADB and Royal Government of Netherlands.

Badiani, R. and Jessoe, K.K. (2011), 'Electricity subsidies for agriculture: Evaluating the impact and persistence of these subsidies in India'. *Draft paper*. Available from: [kkjessoe.ucdavis.edu/ResearchPapers/BJ\\_DRAFT.pdf](http://kkjessoe.ucdavis.edu/ResearchPapers/BJ_DRAFT.pdf).

Dorward, A. (2009), 'Rethinking Agricultural Input Subsidy Programmes in a Changing World'. Paper prepared for the Trade and Markets Division, Food and Agriculture Organization of the United Nations. 45-46. Available at: <http://www.oecd.org/dataoecd/14/37/46384527.pdf>.

Dawn, (2003), Available from: <http://www.dawn.com/2011/12/03/pakistan-pays-rs-1-trillion-in-energy-subsidies-hafeez.html>

Government of Balochistan. (2009-10), 'Agriculture Statistics of Balochistan'. Department of Agriculture Extension, Government of Balochistan, Pakistan.

Government of Balochistan. (1997), Irrigation and Power department.

Government of Balochistan, (2006), 'Integrated Water Resource Management (IWRM) Policy'. Department of Irrigation and Power. 25-26.

Harris, JM. (2006), 'Environmental and natural resource economics: A contemporary approach'. 2nd edn, Houghton Mifflin Company, Boston. 347.

International Union for Conservation of Nature. (2000), *Balochistan Conservation Strategy*. IUCN Pakistan and GoB, Karachi, Pakistan, xxxii.

Nasrullah, Maqsood A.K, Aamir, M., Mohammad, G. K, Ehsanullah, K. (2011), 'Socio-economic Effects of Water Scarcity in Tehsil Karezat District Pishin Balochistan', *Journal of Applied and Emerging Sciences*, 2(2), 116-123. Available from: <http://www.buitms.edu.pk/Research%20Journal/rjdec2011.pdf>

Qureshi, A.S., Peter G., McCormick, A. Sarwar., Bharat R. S. (2009), 'Water Resource

Management Challenges and Prospects of Sustainable Groundwater Management in the Indus Basin, Pakistan'. DOI 10.1007/s11269-009-9513-3.

Shah, T. (1993), 'Groundwater Markets and Irrigation Development. *Political Economy and Practical Policy*'. Bombay; Oxford University Press.

State Bank of Pakistan (2012), '*Monetary Policy Statement July 2011*'. Available from: [http://www.sbp.org.pk/m\\_policy/2011/MPS-Jul-11-Eng.pdf](http://www.sbp.org.pk/m_policy/2011/MPS-Jul-11-Eng.pdf)

Van Steenbergen, F. (2006), 'Promoting local management in groundwater', *Hydrological Journal*, 14:380-391.

Wiggins, S., Brooks. (2010), 'The Use of Input Subsidies in Developing Countries', *Global Forum on Agriculture. Policies for Agricultural Development, Poverty Reduction and Food Security* OECD Headquarters, Paris. Available from: <http://www.oecd.org/dataoecd/50/35/46340359.pdf>