Agricultural Policies and their Impact on Transition to the Current Agricultural Practices in Sindh

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CERTIFICATE

This is to certify that this thesis entitled: **"Agricultural Policies and their Impact on Transition to the Current Agricultural Practices in Sindh".** submitted by Fatima Mallick is accepted in its present form by the PIDE School of Public Policy, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Environmental Economics**.

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LIST OF ABBREVIATIONS

GOP	Government of Pakistan
FAO	Food and Agriculture Organization
USD	United states Dollar
OECD	Organization for Economic Cooperation and Development
SRO	Statutory Regulatory Orders
MNFSR	Ministry of National Food Security and Research
GDP	Gross Domestic Product
RA	Rice Area
SA	Sugarcane Area
CA	Cotton Area
NPC	National Protection Coefficient
DRC	Domestic Resource Cost
CWW	Canal Water Withdrawal
MP	Market Price
SP	Support Price
APCom	Agricultural Price Commission
API	Agriculture Policy Institute

ABSTRACT

Being water stressed agrarian economy; Pakistan has been suffering from water security issues since many years. This study aims to identify the cropping choices of Pakistani farmers in Sindh province regarding three main *Kharif* season crops i.e. Cotton, Rice and Sugarcane. These crops have been considered highly water intensive yet they have been regularly cultivated in the country. Along with this, farmer's profitability in these crops and gender division has also been discussed. Special emphasis has been paid to female farm worker's socioeconomic well-being. For this study, a time series analysis has been done of the secondary data obtained from Agricultural Policy Reports issued by the Agricultural Policy Institute (API) which is a government organization. For the validity of the data, interviews were conducted from farmers in various districts of Sindh. Latent content analysis technique was applied on the secondary data while the results were also statistically examined using simple OLS technique. The results indicate that the cropping pattern has been on an upward trend, except for some years. It has been influenced by market and support prices but mainly the choice of crop cultivation resides with the farmers, who, in most cases, are very limited in crop selection. The regression results indicate that sugarcane, rice and cotton are water intensive crops as they have been perceived and cannot stand water scarce conditions. Gender division or labour wage/employment has not been discussed in the documents. However, interviews have revealed that females are involved in crop sowing and harvesting process, either on their own or with male farm workers. The process of wage distribution has still not been clear, either in policies or through interviews. The income of female farm workers has mostly been associated with cattle farming. The introduction of improved technology has cut this extra income by providing machinery and chemicals. Suitable policy recommendations have also been offered to the concerned government authorities.

Chapter I

INTRODUCTION

1.1 Background and Rationale

Pakistan is listed among the low income developing countries. Since agriculture is the main driver for development, the country is dependent upon this sector for its 18.9% contribution to GDP and 43.2% of the labour force engagement as of 2018. It is also accredited as a foreign exchange earning sector besides stimulating the growth due to backward and forward linkages in other sectors of the economy (Pakistan Economic Survey, 2018). More importantly, the agriculture is also crucial for food security and fibre demand of a citizenry that is growing annually at 2% (Pakistan Population, 2019).

The water is strongly linked with agriculture and food security in Pakistan. The escalated energy and food demand for its burgeoning population are subject to sufficient water availability in the Indus River system that transcends this arid geography (Iqbal, 2017). The two dams namely Tarbela and Mangla, which are the major water reservoirs of Pakistan, are also losing their storage capacity which may further the water-stress in the country (FAO, 2018). Deterioration of the existing water storage and difficulties in carrying out replacement works and new storage facilities cause the country to waste water worth approximately USD 70 billion without giving any appreciable economic, social and environmental benefit (Iqbal, 2017).

Add-in is the country's cropping choices. According to national statistics (Government of Pakistan, 2018), Pakistan uses its scarce water resources to produce and export water-intensive crops, while at the same time importing less water-

consuming crops, which are also critical for nation's food security. This leads to a potentially unhealthy and unsustainable situation where production and areas under rice, cotton and sugarcane are increased while production and areas under wheat, oil seeds, pulses and legumes are decreased or stay stagnant. Given the current global trends in irrigation investments (Turral et al., 2010; Ward, 2010) and competing demand from residential and industrial uses, its near impossible to develop additional physical infrastructure to sustain its current cropping patterns.

Over the years, the government of Pakistan (GOP) has introduced numerous agricultural subsidies to facilitate the sector's growth. These were given both explicitly, in terms of fertilizer, pesticides, seeds, machinery and plant protection, and implicitly, in terms of irrigation water, credit and electricity (Chaudhry and Sahibzada, 1995; Pakistan Economic Survey, 2018). Along with this, support prices of each crop have been fixed by the government to ensure that the farmer do not have to face losses on their harvest (API). Thus, it can be said that the country's policymakers have been concerned with sustainable ways to regulate the water-food-energy nexus (Siddiqi, 2014).

However, contrary to global trends in virtual water (Tamea et al., 2014; Zhang et al., 2016), one wonders why policymakers seemingly promote such irrational cropping practices in a water-stressed country like Pakistan. Additionally, it has been reported that due to increased water consumption in the upper Indus, there has been a continuous water deficiency in the lower Indus regions, i.e. the Sindh province (Water crisis and Sindh agriculture) which accounts for water scarcity issues in the said province. Answers to these questions demand a thorough analysis of agricultural and water policies that regulate the irrigated agriculture in Pakistan's Sindh province.

1.2 Research Gap

A detailed review of previous studies done on agriculture and affiliated activities (seasonal crops, cropping pattern, farmer's profitability, gender division etc.) in Sindh provide sufficient information about the province's agricultural landscape. However, the current literature is lacking on understanding the reasons as why these particular water intensive crops are being continuously cultivated in the province. This is mainly because the documents containing public agricultural policies have not been brought in common knowledge previously. Also, gender division with regards to public policies; particularly the socio-economic impact on female farm workers has not been assessed in previous literature. This study aims to bridge these gaps between crop choice and rational reasoning behind it along with giving the government's perspective regarding gender division in the major Kharif crops i.e. cotton, rice and sugarcane, of Sindh from 1980 to 2015. It will lead to better understanding as why farmers cultivate these particular crops and how public support has been effective in this regard.

1.3 Purpose of the Study

The main purpose of the study is to analyze the provincial and federal level agricultural policies for Sindh, from 1980 onwards:

I. To understand the effect of the policies on the patterns of cultivation of cotton, rice and sugarcane
II. To critically examine the policies for evidence of gender based labor division and if/any special facilities are being provided for the female farm workers by the government

1.4 Objectives

To understand the impacts caused by the federal and Sindh province's agricultural policies from 1980 onwards, the study will analyze:

I. The legacy of existing cropping patterns related to rice, cotton and sugarcane in Sindh Province and their impact on agricultural water usage

II. The extent to which gender roles and labor division has been indirectly affected by the policies, particularly with reference to the socio-economic wellbeing of female farm workers.

1.5 Organization of the Research

Following this introductory chapter, the rest of the study is organized as follows: Chapter 2 will glean and analyze state of the art literature review, particularly on highlighting gender and water nexus and will creates links with review on agricultural practices and policies to be carried out as the part the second thesis carried out by Ashfaq which is part of the same larger project supported by CSIRO titled: *Agricultural Policies and their Impact on Transition to the Current Agricultural Practices in Sindh Province*. Chapter 3 gives study area and methodological details. Based on the content analysis of agricultural policies and notifications and Statutory Regulatory Orders (SROs), Chapter 4 will trace the development or agricultural policies, such as input, irrigation water, seed, credit, fertilizer and pesticide policies, and their effects on the three crops namely: rice, cotton and sugarcane in Sindh. It will also put gender and water lens on the outcomes of policies. Finally, Chapter 6 will draw conclusions and offer policy recommendations.

Chapter II

LITERATURE REVIEW

Being the part of a larger comparative research project, the section on literature review presents the findings related to gender components. However, the broader picture of the way the agricultural polices since 1980s facilitated the cultivation of water intense crops and impinged gender roles, it fits quite precisely.

2.1 Social and Environmental Outcomes of Agricultural Policies

Agriculture has been the economic mainstay in many countries of Asia and Africa. It is a source of financial independence for farmers and budding GDP for a nation. Since its discovery by man, it has always been gender-neutral. Both men and women have participated in farming and have worked their fair share in the fields. From the early days, men held the responsibility of providing for the family, but the women of the house helped them in the fields along with doing the housework. Its importance can be estimated by the fact that ancient civilizations in Asia, Africa and Americas turned stationary from nomads on the basis of agriculture (Hobbs, n.d.).

An important parameter for analyzing the agricultural practices of an area is the agricultural policies governing that area. However, since the policies are not directly applied on the land, a large number of policy indicators are used as a measure of policy application. One of them is farm size. Agricultural policies have varied effects depending upon the size of farm holdings. Josling (1974) studied the impact of agricultural policies in Europe and UK and concluded the 'farm problem' to be more prominent in Europe than UK. The inheritance laws in Europe allow for fragmentation of land resulting in less effective implementation of agricultural policies.

Another important aspect of agricultural policies is their effect on the environment of that area. Pesticide and nitrate runoff, usage of waste water for irrigating fields, improper disposal of animal waste and accompanying bacterial contamination, and foul smell from poultry farms adversely effects the quality of life in the surrounding regions. An economic analysis of the environmental impact of agricultural policies suggests that in a simple deficiency payment program, the demand price precedes the supply price for most farmers, resulting in deadweight efficiency loss. An environmental directive that works to increase the marginal cost of production and reduces consumer and producer surplus in the affected market, reduces the margin of the deadweight loss as well, especially for crops like cotton and rice (Lichtenberg, 2002). But these kinds of regulations are scarcely seen as the feudal landlords have deep relations with the government authorities in most developing countries, proving to be a hindrance in the way of environmental safety.

A different kind of social issue arises in the form of choice of crop. Cropping is a matter of gender choice in some regions. One often heard misleading comment is that cash crops and export crops are ‘male crops’ or cultivated by men, while ‘subsistence crops’ are female crops or cultivated by women (Koopman, 1992). It is difficult to tell, however, whether subsistence crop cultivation is a matter of choice for women or because they have limited mobility towards inputs, credit, land, market and information (Doss, 2001a). Recent effort on gender related cultivation choices in Ghana reveals that these distinctions are tricky; women are also associated with cash cropping, although to a lesser extinct than men. Similarly, many men are occupied in the production of food crops for daily consumption (Doss, 2001b).

However, these factors result in lowering the socioeconomic wellbeing of female farm workers. In addition, there is a lot of health risks involved in the irrigation process.

Study reveals that farmers are exposed to diseases such as skin ailments, eczema, malaria, tuberculosis, breathing disorders, etc. National agencies overlook these issues while writing irrigation policies which results in detrimental health effects on the workers especially female farm workers.

2.2 Water-land and Gender Discourse

Around two three decades ago, there was no discourse along the lines of 'gender issues in agriculture'. It has been understood that the rightful place of a woman was being a housewife, and that of a man; as the sole breadwinner. This prominence on women's roles as only housewives has wrongfully strengthened the perception that women have only been 'helping' their husbands in the fields. This has resulted in becoming a reason for justifying their exclusion from agricultural and irrigation policy and intrusion (Van Koppen and Hussain, 2007).

The issue in the irrigation process lies in the ownership of land. Most infrastructures are more or less land bound. Thus, it is the physical design, the site selection and the division of labor in the fields that are crucial to the irrigation practice (van Koppen, 1998). Land ownership is a cause of social status and political power, and it forms associations both within and outside the household. Legally speaking, women have fought for, and succeeded in inheriting and controlling land rights; but in reality, most women are still disinherited (Agarwal, 1994). Globally, women do majority of work in agriculture but it is still men, for the most part, that own the land and control women's work power, giving them the right to make agricultural decisions in the patriarchal social systems (Sachs, 1996).

Another hindrance in the way of female land ownership is the association of water rights to land rights. It is seen globally that water and land rights are interconnected

and water for irrigation will only be accessible to those farmers who own the lands. In the context of irrigation, except for female headed farms, women are often viewed as farm help. At community level, it is the men who are regarded as the household representatives for water related issues, presuming that both men and women are on the same page (Meinzen-Dick and Zwarteveen, 1998).

A safe and promising option for female farmers here is the role of state and state related user associations in providing them with their rights. An analysis of the global state policies, however, reveals that the state also promotes the patriarchal system in irrigation. This is because the Water User's organizations are mostly male dominated. The gender ratio is extremely generous in favor of men in terms of employment as irrigation researchers, experts, engineers, planners or managers. Indeed, men are perceived to be more professionally related and involved with irrigation (Zwarteveen, 2008). Results from studies carried out in Sri Lanka, Nepal, India and Pakistan show that women have much lower participation rate than men in the water user's associations in these countries (Meinzen-Dick and Zwarteveen, 1998).

These issues have rendered majority of female workers powerless and working on farms as paid and unpaid laborers. They work as unpaid laborers on their family farms or as paid laborers on someone else's farms. Wage employment in agriculture is also gender biased. It is seen that women are more often excluded from carrying out high paid jobs like construction and maintenance work and may be restricted, socially or mentally, to executing the lowest paid work. Even if they do equal amount of work, the wage difference still remains. For example, in Sri Lanka the male labor was found to be paid 10% more than the female labor (Van Koppen and Hussain, 2007). Accordingly, Norwegian women earn about 70 percent to 80 percent of what men earn (Marit S. Haugen and Berit Brandth, n.d.).

Women's incomes are crucial for the wellbeing of their households. In the poorest households in Bangladesh, for example, women contribute one-third to half of the household income (Safilios-Rothschild and Mahmud, 1989). Moreover, a larger share of women's incomes benefit their dependents, as reported in Asia (Agarwal, 1994; (Safilios-Rothschild, 1991) and in Africa. Female-headed households depend even more upon women's incomes. These households are generally among the poorest.

Nutrition, health and gender outcomes are influenced by irrigation through numerous potential pathways. In Africa, irrigation may also lead to reductions in nutrition and health (Mekonnen, n.d.). In Vietnam and other underdeveloped countries, there is a renewed interest in urban wastewater usage for agriculture. However, one problem often reported by wastewater farmers themselves is skin diseases. Dermatitis and superficial fungal infections are, by far, the most common skin diagnoses (Thuy Trang et al., n.d.). Similarly, a high incidence rate of malaria is found in rice paddies in Sri Lanka (Boelee, 2003).

2.3 Agriculture and Gender in Pakistan

The situation in Pakistan is no different than most developing nations of the world. The focus of the review include the plain areas of Punjab and Sindh that account for over nine-tenths of the rural population, and a significant proportion of value added in crop agriculture (Munawar-Ishfaq, 2010). These lands witnessed many agricultural innovations like the acclaimed Green Revolution in 1960s which turned out only to be a temporary success, and that too mostly for the rich (Niazi, 2004). In Sindh, the ownership of farms is mostly private and historically, the average farm size has declined from 13.1 acres in 1970s to 7.7 acres in 2000 to 5 acres in 2010 (*Pakistan Bureau of Statistics*, 2010).

The scientific literature on agriculture is gender biased in a way that it privileges male views while also being exclusive by ignoring poor and more marginal populations such as women (Drucza and Peveri, 2018). Being a Muslim majority country, there is a strong Islamic influence felt in the political, social and economic life in Pakistan. *Purdah* or veil is an important part of the social and religious fabric of the people.

There is generally a noticeable gap in the literature in assessing the numerous aspects of women's status. Pakistan is wrongly viewed as an Islamic monolithic community by many scholars, which leads to the homogeneous treatment of Pakistani women as powerless objects, lacking agency and decision-making power (Sathar and Kazi, 2000). There are numerous deceptive examples that assume *purdah* denies agency for rural women and make them appear as male-dependent, socially, economically and in all other thinkable ways. On the contrary, the necessity to leave the house depends mostly upon the economic wellbeing of the household. In most cases, agency is freely exercised by poor peasants who cannot afford the luxury of making their women stay in home (Mumtaz and Salway, 2005).

However, *purdah* does play a role in women's effort not being officially reported or published. Rural women may have the freedom to work but they still observe the social norm of not verbally engaging with strange men. Thus, government officials, in majority cases men, may try to approach them (for census, extension projects etc) have to speak with the leading male of that house who consider it dishonourable to speak about their women with other men (Drucza and Peveri, 2018). Thus, there is a layer of complexity to the freedom of movement and work of rural women. Similarly, women feel intimidated while explaining their farm issues, like water usage, to the local government authorities because of the all-male work culture in those

associations (Meinzen-Dick and Zwarteveen, 1998). Thus, their presence is mostly veiled from public view.

The participation of women in cotton harvesting deserves special recognition yet, ironically, the area around women's role in cropping becomes even grayer when it comes to cotton activities. This may be due to the industrial nature of cotton picking (Munawar-Ishfaq, 2010). Cotton is an important cash crop and anything grown for cash in Pakistan becomes the dominion of men, because of their free mobility and, thereby, domination in market spaces. Cotton harvesting is a purely female work. Across Punjab and Sindh, a large population of women cotton pickers work long hours in the fields while being at the mercy of landlords and facing occupational hazards and health costs. Yet they still remain unaccounted for in the agricultural literature and hopelessly await due recognition in the daily headlines as well as in academic research (Siegmann and Shaheen, 2008)

It is common practice in the Sindh province that women are actually involved in a range of agricultural tasks, either alone or as part of a family unit. But in a typical Pakistani context, it is neither always possible nor desirable for women to actively or vocally contest or lobby for control over resources for fear of physical retaliation, apprehension or torture or even due to cultural norms (Nyborg, 2002). However, evidence suggests that women tend to resist against efforts which they deem restrictive or uneconomic for them. Research conducted by Joekes (1995) in Hunza district of Gilgit Baltistan indicate that women disapprove any technology that renders their efforts ineffective and cease their economic opportunities. Thus, it can be said that even special programs centred on women's' development can overlook important aspects of women's decision making and portray misleading picture of women in agriculture.

Agricultural literature (like agricultural development project reports) frequently blame 'culture' or 'gender' behind the failure of their projects to reach women, whereas in reality, this let down stems from the absence of thorough gender analysis at the research/project design phase (Drucza and Peveri, 2018). However, women's work may also be veiled voluntarily. According to Carpenter (2001), the case of Pakistan for rural households suggests that the veils that conceal women's work actually shield a portion of household production from the risks and extractions inherent in their involvement with development. For States and other development interests, women's work involves a subsidy which is intentionally obscured. Women's invisible work, in other words, is not invisible because it is not seen, but rather the process of economic development -for both rural households and States and other development actors- requires that it be hidden.

2.4 Summary of Literature Review

Literature regarding agricultural policies has been viewed with regards to impacts of the policies on socio-economic, environmental, health, water land and gender discourse and a special reference to gender divide in Sindh agriculture. Farm size has been taken as an indicator for social influences and the literature reveals that fragmented lands, like those in Sindh, are subjected to partial implementation of policies. Labor wage has been taken as economic indicator and it is seen that female wages are less than male labor because of the differential nature of work. It is seen that the surrounding areas of agricultural lands are some of the most polluted ones due to chemical run-off from the fields that degrade the nearby streams and also seep into the ground. The literature also studies the health impacts posed on the agricultural labors, especially the women who are exposed to diseases like eczema, tuberculosis, breathing disorders, skin ailments and malaria etc.

The literature also glances over irrigated land ownership which is correlated with water rights which are mainly residing with males. Also, the water user's association is male dominated so the problem persists. Along with this, there is a problem of the documentation problem regarding female participation in the fields. Many studies overlook the female participation and promote the concept of veil or *purdah* as an excuse for low female participation. However, mobility of females is purely on the basis of economic factors of the household, especially in peasant families. The female oriented agricultural welfare programs have not been highly successful in this regard due to structural designs. Thus, a thorough situational analysis of the socio-cultural and economic prospects of the gender divide in agricultural arena is viewed in the study.

Chapter III

DATA AND METHODOLOGY

3.1 Study Area

Sindh Province spans over an area 14.1 million hectors or about 18% of the land area of Pakistan. It is a hot a semi-arid region receiving average rainfall below 250 mm and mostly characterizes saline and brackish groundwater resources. Nevertheless, Sindh province is one of the major beneficiaries of water resources development in Pakistan and appropriates around 41% of the Indus River flows to cultivate 32% of the irrigated agricultural land in Pakistan. Sindh's irrigation network ranks as the 5th largest in the world and irrigates about five million hectares of farmlands through 14 canals, 1,446 distributaries and minors and 45,000 water courses (Memon 2006; Memon and Mustafa 2012). There are about 13 existing surface drainage systems in Sindh, which serve a total area of over 3.5 million hectares and have an aggregate length of about 4,800 km (Facts, n.d.)

Currently, 40% of the land in Sindh is cultivable. The total arable area of Sindh is 5.88 million hectares while the total cropped area is 3.10 million hectares revealing nearly 2.32 million hectares that is lost due to salinity (Pakistan and Gulf Economist, 2000) The major crops of Sindh are rice, cotton, sugarcane and wheat which consume about 68% of the total cropped area. Of the total output in Pakistan, 35% of Rice, 20% of the cotton and 28% of sugarcane produced in this province (Sindh Agriculture). All of these are cultivated through the Indus River because they are not rain fed crops and the underground water in the province is saline. Rice is cultivated in the upper Sindh region of Larkana, Shikarpur and Jacobabad. Sugarcane is grown in lower Sindh areas of Hyderabad, Badin and Thatta whereas cotton is cultivated

throughout the province in Sukkar, Khairpur, Dadu, Nawabshah, Hyderabad and Mirpurkhas among other districts (Agricuture Department Govt. of Sindh).

3.2 Data Sources

The data pertaining to this research will come mainly through three sources: (1) all policy statements issued since 1980. These include written policy documents such as input, irrigation water seed, credit, fertilizer and pesticide policies, as well as statutory regulatory orders and agricultural notifications; (2) Interviews with the provincial representatives of the irrigation and agricultural departments; (3) Relevant literature such as reports, Sindh Development Statistics, published journals articles that may be helpful in critical appreciation of the findings of the above two sources.

In terms of public policy documents, only one document has been issued annually. This is the Agriculture Policy Document issued by the Agriculture Policy Institute (API), working under the Ministry of National Food Security and Research (MNFSR), Islamabad. The institute is a research facility that publishes yearly public price documents regarding every major and minor crop in all the provinces. The documents are mainly concerned with cropping patterns, market, support and international market prices, cost of production, sowing and harvesting seasons and water requirements of the crops. Since, these documents are the only reliable source of public agricultural policies, they have been taken as standard for the study. Thus, only the variables present in these documents are analyzed in the study.

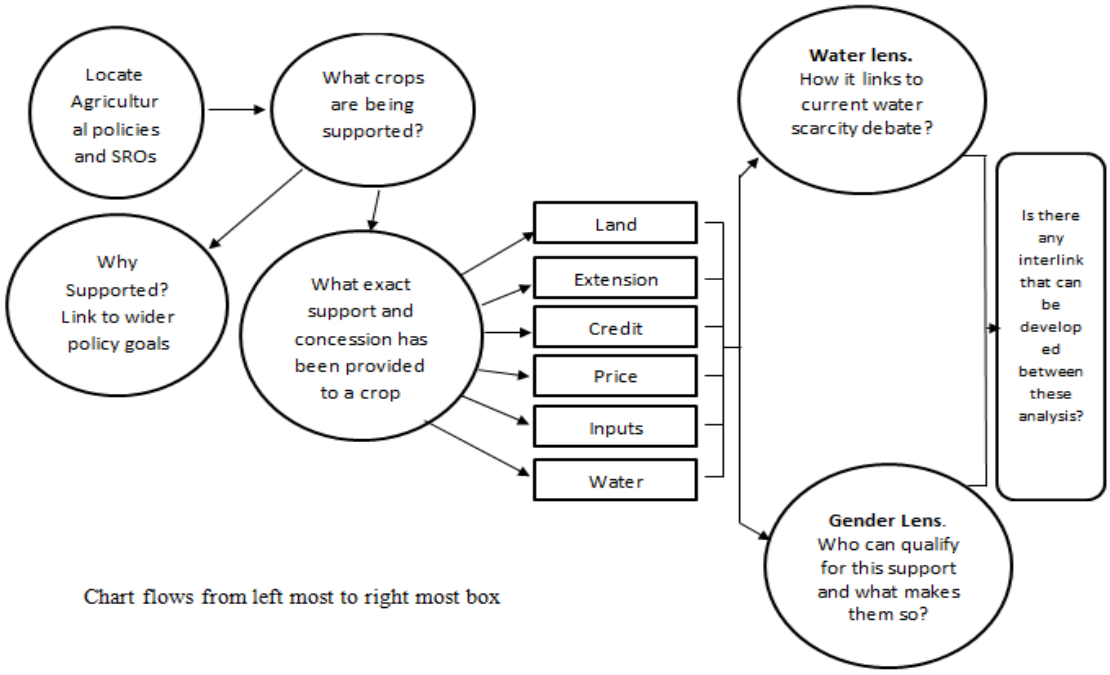
3.3 Study Approach and Methods

The study will involve content analysis to critically analyze the documents taken from various federal and provincial sources. Content analysis has been identified as the most applicable research method in this case as it analysis the documents and texts

that seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner (Bryman, 2012). The documents will include federal, Sindh Province and its district level laws, regulations, guidelines related to agricultural production of the three crops mentioned above, and compare them with present area, production, yield of crops to reveal possible correlation and causations. The required information will be obtained through scholarly publication, publicly available documents such as federal policies and government reports and grey literature such as provincial statutory regulatory orders (SROs) and other devices that regulate the agricultural affairs in the country. These data sources will be thematically analyzed through clearly formulated set of questions and associated historical context. Owing to the need of the research, interviews with the relevant government officials will also be done to understand the policymaker's perspective.

Particularly in content analysis, latent content analysis will be applied for this study. It is the process of the elucidation of contents, where the underlying meaning behind the words is analyzed and interpreted to explain what is actually meant by the author. Awojobi and Adeokun (2012) successfully applied this method to analyze Nigerian agricultural policies. Memon and Thapa (2016) developed a similar approach in their study of forest policies in Pakistan, as shown in Figure 1. They analyzed the content of forest policies in Pakistan and tried to explain various changes in the management of mangroves forest that one could observed on the ground with the help of relevant statistics, interview data and other scholarly resources available to them. A similar approach to policy analysis having a clearly set criteria and indicators has been developed for this study to understand the evolution of policy support for some crops on the cost of others and their implication for water and food security in Pakistan.

Figure 3.2: Criteria and approach to policy analysis



Two dimensions, namely gender and water, have been taken to analyze the agricultural policies. The indicator used for gender is female farm worker's income. Since female farm workers constitute a fair share of total farm workers, their incomes determine the level of socioeconomic prosperity that is earned through them, along with the establishment of their free will to work in the farm. Water consumption associated with the crops is taken as the indicator for water usage. Being water stressed country, it is important to investigate whether government's agricultural policies have focused on efficient water use by promoting cultivation of less water intensive crops or through better water management system. That is why water consumption has been selected as an indicator of irrigation water usage.

3.4 Analytical Tools

In order to statistically support the qualitative arguments of the study, multiple linear regressions are used by applying OLS model on the data. Such type of regression

method has been previously applied by Sheikh et al., (1988) and Khaleel et al., (1988) in their study of the factors influencing cropping patterns and intensity in North and South Punjab respectively. For better understanding and uniformity in the results, the cropping pattern of each crop has been separately regressed against the same explanatory variables resulting in three models, one for each crop i.e. rice, cotton and sugarcane.

3.4.1 Variable Description

After careful evaluation of data and research objectives and review of previous studies done on similar issue in different areas, the following variables have been selected as suitable explanatory variables for each model.

Area of Competing Crops

The crops selected for the study are of the same cropping season i.e. Kharif. Both rice and sugarcane have been cultivated in the same districts for decades (Appendix I) while cotton has been cultivated in different districts, with only a minor share in the combined districts of rice and sugarcane. It is clear from the data provided by the API documents that all three crops are grown during the same months and compete for the same area; therefore, area of competing crops is selected as a necessary variable for determining the area of a particular crop.

Price Ratio of Competing Crops

Studies show that the price of one crop is liable to affect the price of another crop, in case of competitive or complementary crops (Ali, 1990). This affect is amplified when two or more crops are competitive in terms of cropping season, cropping area and agricultural resources. These prices include support prices and market or wholesale prices of the crops. For long, farming decisions have been influenced by price factors as the decision to cultivate a particular crop may result in low production

of another competing crop sown later in the same area. For this purpose, the prices are taken as a ratio of market price to support price in this study as, on average, the market price is always greater than the support price. Since the farmer cannot get an exact figure of that year's market price before harvest, the best guess is to forecast the price based on previous year's price. That is why the price ratio is taken with one year lag in the study.

Price Ratio of Particular Crop

The market price of the crop which is to be sown in a particular season has a significant impact on the farmer's decision to cultivate that crop (Ali, 1990). If a crop presents a stable or rising trend through the years, farmer's willingness to cultivate that crop will be higher than a crop with a falling market price. The prices of the crop are taken in ratio of market price to support price. The value of the price ratio determines how much more, or less, money is the farmer getting from the market as compared to the promised support price. The price ratio is taken with one year lag as the farmer bases his cultivation decision on previous year's market price.

Price of Urea

Urea is an inexpensive form of nitrogen fertilizer which contains 46% N. It is commercially sold in the form of small dry pellets and is useful to restore the natural nitrogen level of the soil resulting in improved soil quality and high yield of the crop. Urea fertilizer is applied to wet soil before sowing begins or on standing crops. This gives time to the fertilizer to break down into nitrates which are easily absorbed by the soil. It is considered as one of the most important fertilizers for nearly all major crops and a chief input in the cultivation process having the highest cost among all inputs (Sehto et al., 2018). Hence, it is estimated that the price of urea may have a

negative impact on the productivity of a crop as higher prices would result in less usage of the fertilizer (Ali, 1990).

Price of DAP

Di-ammonium phosphate (DAP) is the most concentrated phosphoric fertilizer containing 46% P_2O_5 and 18% N. It is recommended for all crops as basal fertilizer to be applied at the time of sowing for better root proliferation or post planting through fertigation. It is assumed that increase in the price of DAP should result in negative area allocation to a particular crop (Ali, 1990)(Sehto et al., 2018)

Canal Water Consumption

Since water consumption determination is taken as an objective of the study, annual canal water usage for each crop is taken as a measure of water intake by that particular crop. It is taken as that fraction of total water withdrawal in the Kharif season which is used for irrigating a particular crop.

3.4.2 Model I - Area under IRRI Rice Cultivation

$$\mathbf{IA=\beta_0 + \beta_1 ACC + \beta_2 MPI\_1 + \beta_3 SPI\_1 + \beta_4 SPS\_1 + \beta_5 SPC\_1 + \beta_6 PU + \beta_7 PDAP + \beta_8 CWW + U}$$

Where,

IA = IRRI area in ('000' acres)

ACC = Area of competing crops in ('000' acres)

MPI_1 = Market price of IRRI with one year lag (Rs/40kg)

SPI_1 = Support price of IRRI with one year lag (Rs/40kg)

SPS_1 = Support price of sugarcane with one year lag (Rs/40kg)

SPC_1 = Support price of cotton with one year lag (Rs/40kg)

PU = Price of urea (Rs/unit)

PDAP= Price of DAP (Rs/unit)

CWW = Canal water withdrawal for IRRI crop for every season/year (million acre-feet)

U = Error term

3.4.3 Model II – Area under Cotton Cultivation

$$CA=\beta_0 + \beta_1 PDC\_1 + \beta_2 PU + \beta_3 PDAP + \beta_4 CWW + U$$

Where,

CA= Area under cotton crop ('000' acres)

PDC_1 = Price difference of cotton i.e. ratio of market price and support price of cotton

PU = Price of urea (Rs/unit)

PDAP= Price of DAP (Rs/unit)

CWW = Canal water withdrawal for cotton crop for every season/year (million acre-feet)

U = Error term

3.4.4 Model III – Area under Sugarcane Cultivation

$$SA=\beta_0 + \beta_1 MPS\_1 + \beta_2 SPS\_1 + \beta_3 MPC\_1 + \beta_4 MPI\_1 + \beta_5 PU + \beta_6 DAP + \beta_7 CWW + U$$

Where,

SA= Area under sugarcane crop ('000' acres)

MPS_1 = Market price of sugarcane with one year lag (Rs/40kg)

SPS_1 = Support price for sugarcane with one year lag (Rs/40kg)

MPC_1 = Market price for cotton with one year lag (Rs/40kg)

MPI_1 = Market price for IRRI with one year lag (Rs/40kg)

PU = Price of urea (Rs/unit)

PDAP= Price of DAP (Rs/unit)

CWW = Canal water withdrawal for sugarcane crop for every season/year (million acre-feet)

U = Error term

Chapter IV

RESULTS AND DISCUSSION

4.1 Introduction

Sindh is Pakistan's second largest province in area. It is a subtropical region with moderately hot summers and cold winters. It is located between the southwest monsoon from the Indian Ocean and the northeast monsoon deflected by the Himalayan range. The atmosphere is hot and dry and annual rainfall is low, occurring mainly in the monsoon season. In these conditions, agriculture is majorly sustained by the River Indus which is a crucial source of irrigation water for the province. Out of 14.52 million acres of cultivable land, only 7.66 million acres are now available for agriculture. This means that nearly 52.75 per cent of the land is saline. Regardless, Sindh province owns 32 per cent of the total agricultural land in Pakistan and contributes in production of important cash and food crops such as cotton, rice, wheat, maize and sugarcane.

Keeping in view the purpose of the research, a detailed analysis is done of the cropping pattern of three major Kharif crops i.e. cotton, rice and sugarcane. Along with this, farmer profitability and motivation behind these particular crops cultivation is also discussed. Following this, a section on gender roles in agriculture is shared, with a particular reference to these three crops and how the role of female farm worker has evolved over time. The findings of the analysis are recorded in the following sections.

Section I: IRRI Paddy

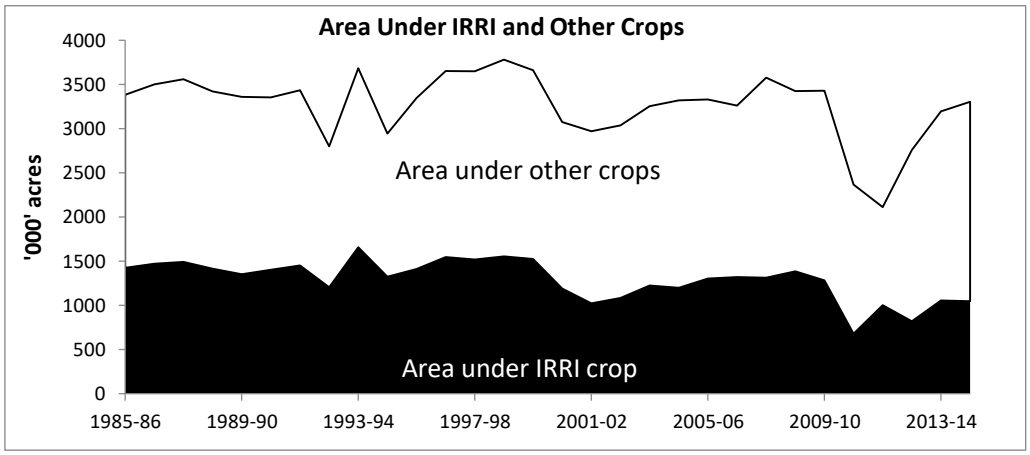
4.1.1 Cropping Pattern

Rice plays an assorted role in Pakistan's agrarian economy. Following wheat, it is the country's second staple food and meets more than 2 million tonnes of food requirement annually. Total area under rice cultivation is around 6.73 million acres (in economic year 2016-17), out of which Sindh province accounts for 1.85 million acres or 27.5 per cent. It is an important source of employment for the rural population. In Pakistan, the Rice crop is a genus of different species. The main two species of rice cultivated in Pakistan are Basmati and IRRI. All additional species are collectively named as '*other*' varieties.

The Basmati is a long grain aromatic variety of superior quality which is mainly cultivated in the Punjab province. Sindh specialises in IRRI production while '*other*' varieties are also cultivated in Punjab. Regardless, rice is cultivated in all four provinces at varying levels of production. All varieties of rice garner a high demand in the international market, especially Basmati rice. Additionally, the crop produces feed for the livestock in the form of rice straw and husk. It is also used as a raw material in the manufacturing industry.

In Sindh, total area under rice cultivation is 1.85 million acres. A time series analysis – since 1985-2015 - of the cultivated area in the province is expressed in Figure 4.1.

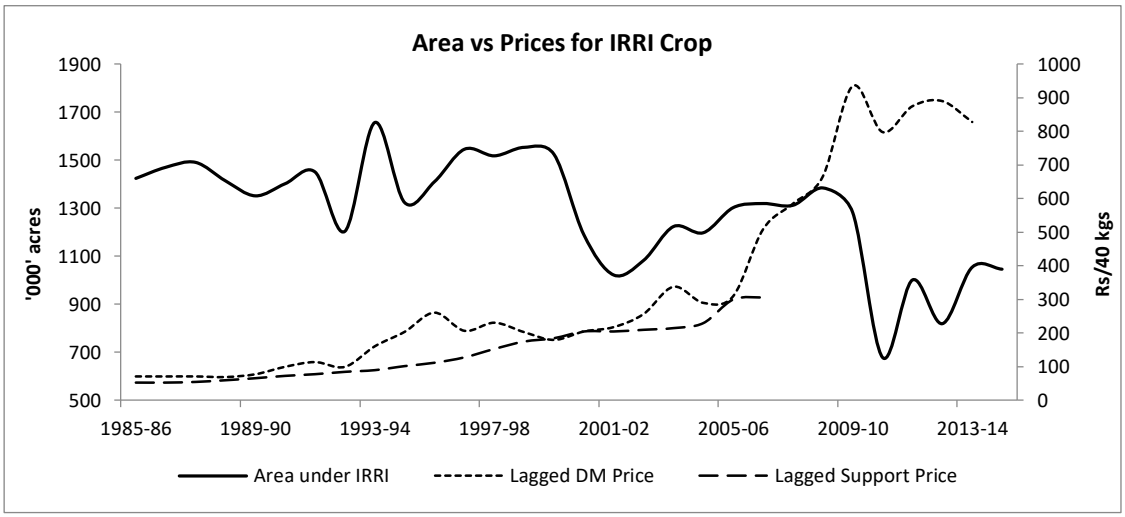
Figure 4.1: Time series analysis of cropping pattern of Rice, 1985-2015



Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

A detailed look at the above Figure 4.1 shows a few highs and lows in the otherwise stable figures for cultivated area. A sudden increase in the cultivated area was observed in the year 1987-88 which was due to the increased support prices offered for rice. According to the policy documents of Agricultural Price Commission (APCom), the support price offered for rice in 1987-88 was Rs 83, which was Rs 12 more than the previous year as seen in Figure 4.2. Another reason may be the increase in ratio of availability of certified seeds to demand which was 250 tons greater than the previous year. However, this increase in area was reversed the very next year due to decrease in support price by Rs 4. Another shift in area was observed in the years 1992-93 and 1993-94 as the area showed a slight decrease but it regained stability the next year. This was mainly due to Rs 10 decrease in support prices and Rs 4 decrease in domestic market price in the previous year. If we look at that in real terms, the loss in support price was 11 per cent for Basmati and 4 per cent for IRRI.

Figure 4.2: Area vs. Market and Support Prices for IRRI in Sindh from 1985-2015



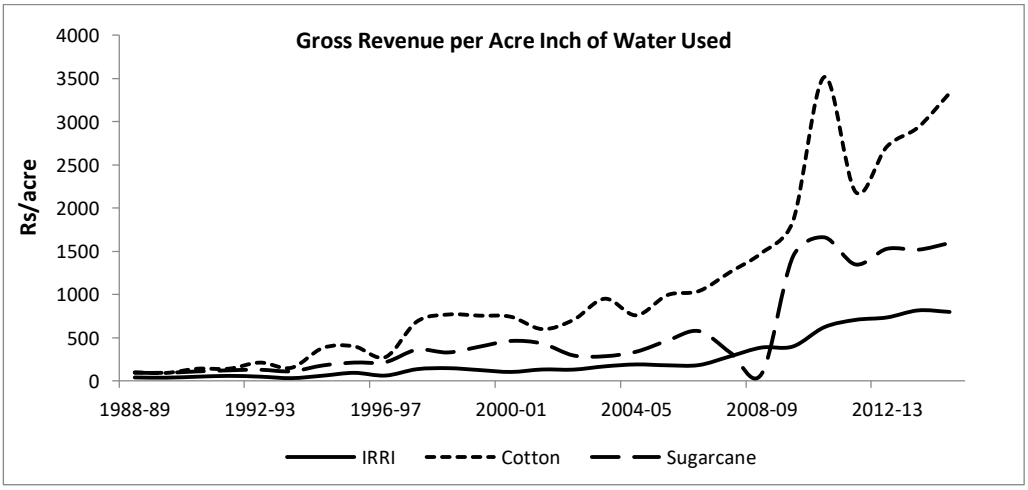
Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

From here on, the crop maintained its area with a steady increase till it hit a sudden low in 2010-11 where the cultivated area dropped from 1.74 million acres to 0.89 million acres. This drastic change can be attributed to the 2010 floods in Pakistan that heavily affected the agriculture sector. Approximately 2 million acres of rice paddy was destroyed from both Punjab and Sindh provinces. This also adversely affected the price statistics. The domestic market prices decreased by 9 per cent that year. After the flood water washed away, nutrient rich fine grained soil was deposited on those plains, adding to the previously decreased crop area. This resulted in cultivated area increase in the following year i.e. 2011-12.

The crop suffered another loss in the 2012-13 as cultivated area was decreased by 0.3 million acres. The reduced area was added to competing crops of rice like cotton, sugarcane and wheat by the farmers in anticipation of better returns to their investment. From figure 3 it can be seen that rice has failed to garner the required returns in terms of gross revenue per acre-inch of water used. since water is an important input, these values carry a profound meaning for the average farmers.. It

can clearly be seen form Figure 4.3 that in 2012-13, the gross revenue per acre inch of water used for rice paddy was at Rs 736, while its value for sugarcane and cotton was Rs 1530 and Rs 2713 respectively. However, these values proved to be temporary and declined to match the economic efficiency values for rice in next years.

Figure 4.3: Gross Revenue per Acre Inch of Water used for IRRI Paddy, 1988-2015



Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

The changes in cropping pattern for rice crop have been majorly governed by prices (domestic market and support), relative economic efficiency between rice and competing crops along with any environmental factors that may alter the pattern temporarily. The farmers adopt a minimum risk strategy and may shift between crops of the same season if they forecast any losses due to economic factors.

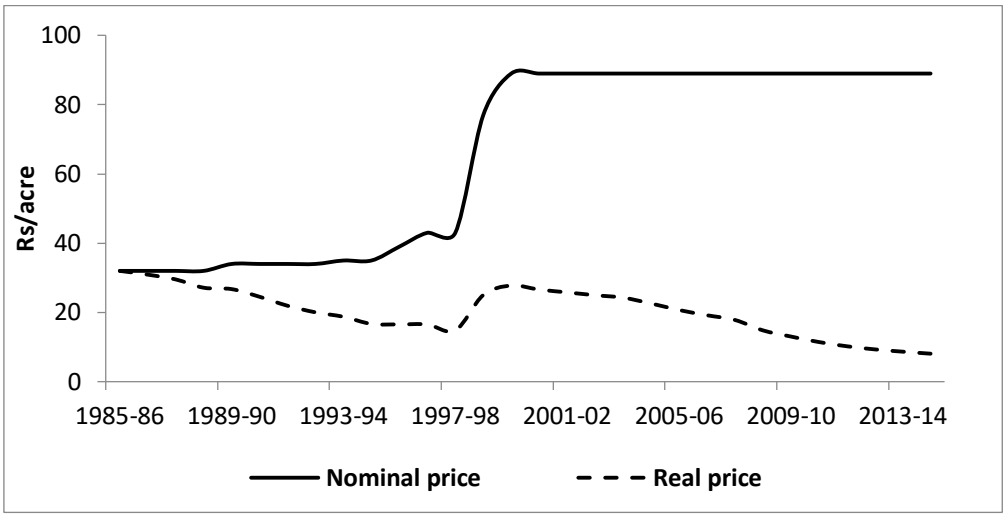
4.1.2 Farmer's Profitability and Water Use:

Being a second staple food and a cash crop in an agrarian based economy, the rice still offers high profits to the farmers. It is a major crop that has continued to attract high demand, both nationally and globally. Particularly the Basmati rice is very popular in the international market with a price of US $ 1077-1238 per ton as of 2014-15. Rice also offers a lot of varieties for both domestic and international market, thus it manages to attract a fair price even in low yield conditions. Another advantage of

this crop is that it is a seasonal Kharif crop and can be cultivated in combination with a Rabi crop such as cotton, maize or sunflower. This allows the farmers to cultivate more crops on the same land and earn extra profits.

The water requirement for the crop has become an issue, due to water scarcity in the Sindh region. Water is mainly provided via barrages constructed on the Indus River. From there on, small streams are made and water is provided to the crops from them. The water price or *Aabyana* for rice crop in Sindh is fixed at Rs32 per acre since 1980 which was increased to Rs89 in 1999-00 after the adoption of flat rate system for water pricing in the country. Although it is such a meagre amount yet its recovery rate is still very low, which makes water nearly free commodity for all (Planning Commission, 2012). After inflation adjustment, this amount accounts to almost nothing. The only constraint for water is its continued scarcity, coupled with the *warabandi* system in which every farmer has his own turn at which he can avail water for his crops. Sometimes a farmers' turn comes so late that all other crops have been watered. This results in late harvest and loss for the farmer.

Figure 4.4: Water Prices for IRRI paddy in Sindh; 1980-2015

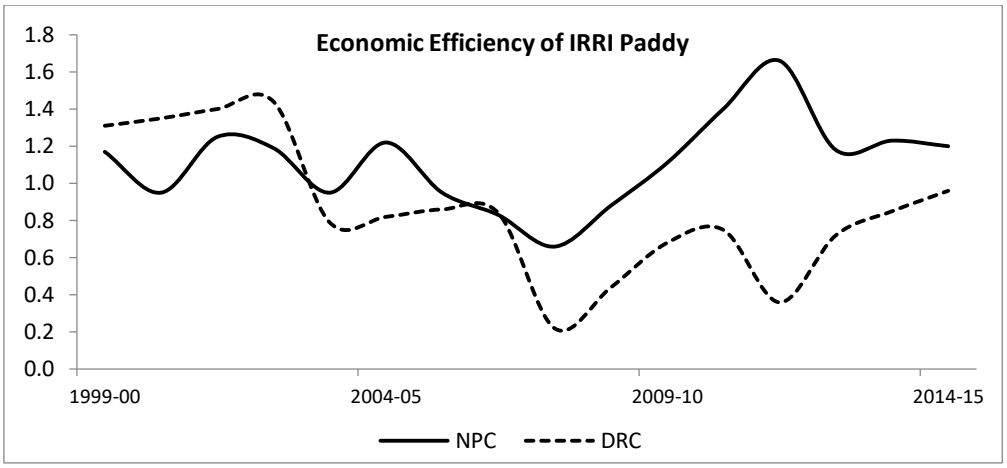


Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

Even after this, the crop fails to fetch the expected revenue in terms of acre-inch of water used (Figure 4.3) as compared to other crops of the same season such as cotton and sugarcane etc.

Figure 4.5 presents a picture of the economic efficiency of rice since year 1999-00 with reference to Nominal Protection Coefficients (NPC), Effective Protection Coefficient (EPC) and Domestic Resource Cost (DRC).

Figure 4.5: Economic Efficiency of IRRI paddy; 1999-2015



Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

Over the years, it can be seen that NPC values for IRRI paddy in Sindh have managed to remain >1. This indicates that the local producers are protected by the government through price policy tools such as support prices. On the contrary, the DRC values have remained below the 1.0 value, apart from the initial years of 1999-02. Low DRC value indicates comparative advantage in local production as opposed to import of rice. This has helped in saving the national exchequer form unnecessary loss by paying import prices.

4.1.3 OLS Regression Results:

Table 4.1: Regression results for IRRI paddy in Sindh

R Square	0.76
Adjusted R Square	0.67
Observations	30

Variables	Coefficients	t statistics	P value
ACC	0.480	3.32	0.003***
MPI_1	.709	1.47	0.156
SPI-1	1.253	1.19	0.249
SPS_1	-5.574	-1.36	0.187
SPC_1	-2.088	-2.34	0.028**
PU	-1.347	-2.23	0.035**
PDAP	0.181	1.12	0.269
CWW	56.844	3.36	0.002***

Note: P values are given at 1%, 5% and 10 % by denoting ***, **, * respectively.

Table 4.1 explains the results for the change in IRRI paddy, as the dependent variable, due to changes in independent variables (i.e. Area of competing crops, Market and Support prices of IRRI, Support prices of cotton and sugarcane, Price of urea and DAP and canal water withdrawal for *Kharif* season crops). Total number of observations in the model was 30. The fitness of the model is verified by f-statistic value of 8.55. The R^2 of the model is healthy with a value of 76 %.

The results show that an increase in 1000 acres of area under competing crops (cotton and sugarcane) results in a significant increase in 0.48 thousand acres of area under IRRI paddy. Rice and sugarcane are alternatively sown crops, i.e. after every

sugarcane crop, a rice crop is cultivated on the same land to replenish the soil nutrients. Thus an increase in sugarcane area would result in the increase in IRRI area. Where cotton is concerned, these crops are sown in different districts of the province and do not offer worthy competition to one another. Lagged market and support price of IRRI show positive relation with IRRI area; however the results are not significant. Lagged support prices of both sugarcane and cotton negatively impact the IRRI area with 1000 acre decrease in sugarcane and cotton areas result in 5.5 thousand acres and 0.2 thousand acres decrease in IRRI paddy. Yet these results are significant only for cotton support prices. The price of Urea has a negative relationship with IRRI area as increase in prices of urea tends to decrease area under IRRI cultivation. Canal water withdrawal shows significant positive relation with IRRI paddy area. An additional 56 thousand acre land is allocated to IRRI by an increase of 1 million acre-feet of canal water withdrawal.

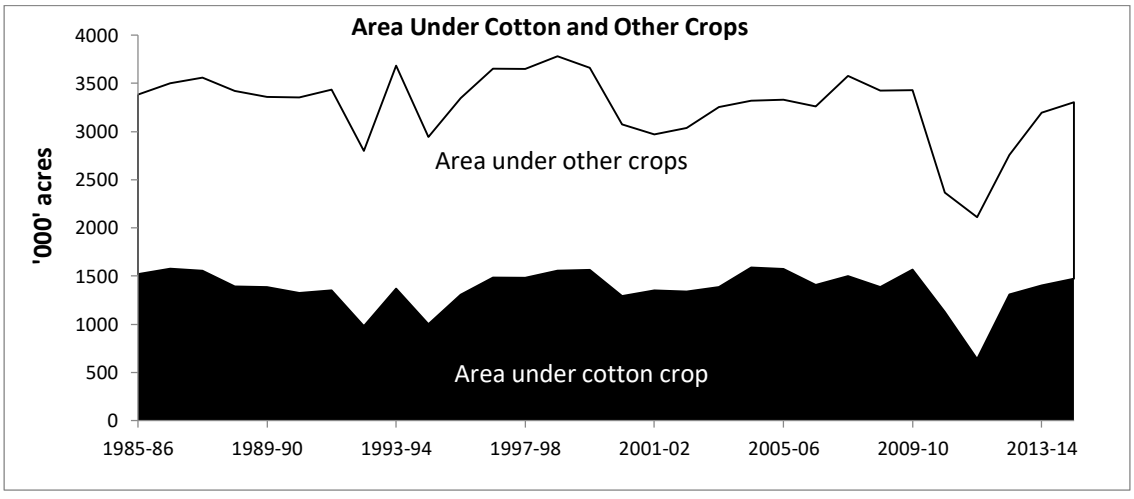
Section II: Cotton Seed

4.1.4 Cropping Pattern

Certain crops are contributing significantly to the economy of the country and cotton is one of those enterprises. Cotton is an important cash crop and the largest source of raw material for the textile industry of Pakistan. The crop is annually cultivated on an area of around 6.5 million acres out of which Sindh accounts for 22 per cent (1.4 million acres) of the cropped area. Cotton farming is a major source of income for rural labour, especially women, as pickers. The cotton sticks are widely used as firewood at village level while the crop also provides raw material to oil extraction mills and cotton seed cake, which is a key source of animal feed. As the crop is susceptible to a host of insects/pests and diseases, its cultivation is a risky proposition.

From 1985-2015, a time series analysis of the cultivated area of cotton crop is depicted in the Figure 4.6. It brings to light the various ups and downs in the cultivated area of cotton crop along with the reasons associated to them.

Figure 4.6: Time series analysis of cropping pattern of Cotton; 1985-2015

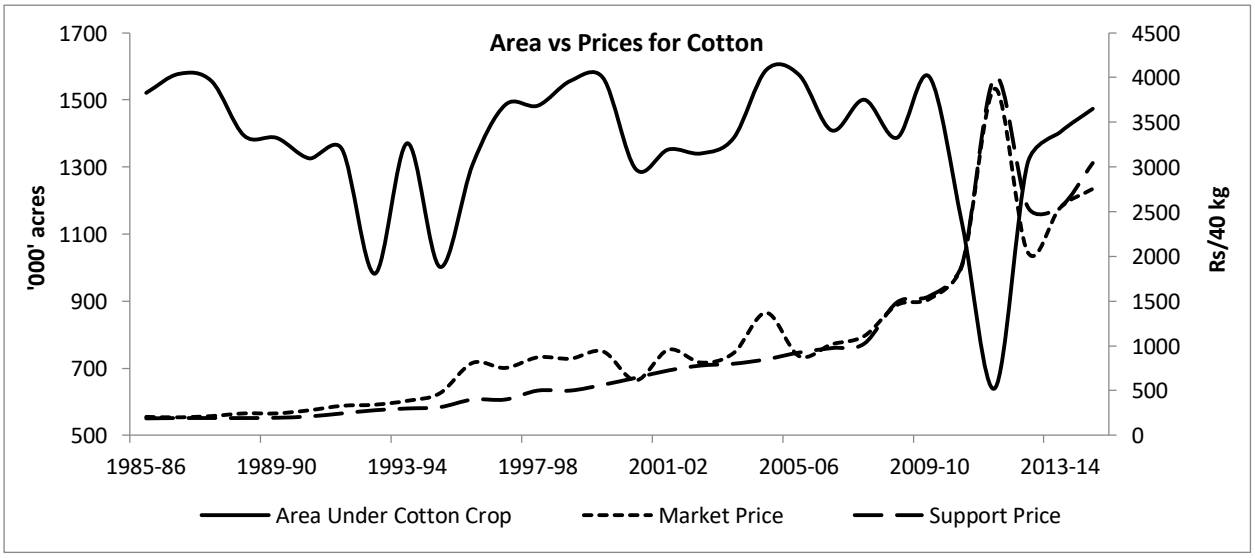


Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

The cotton crop has shown a steady increase over the past years. A major increase in cultivable area was observed in 1987-88 with a peak. A study of the price statistics of the crop revealed an increase of Rs120 in the support prices of cotton for that year which is equal to 60 per cent increase over the previous year, seen in Figure 8. The anticipation of such high support prices acts as a major convincing power for the cotton farmers. However, the support price fell by 11 per cent the following year, bringing the area down. Yet it still remained above the average values.

Further on, the area was found to decline at two points, i.e. in years 1992-93 and 1994-95. Studies besides the policy documents indicate that these setbacks have been due to the flare up of the Cotton Leaf Curl Virus (CLCuV) in 1992 in Punjab and Sindh which destroyed an area of 0.3 million acres and production of 0.58 million tons in Sindh province only (Zia et al., 1998). The Cotton Leaf disease continued for the following couple of years but the area was regained a little in 1993-94. However, the floods in 1994 aggravated the already bad situation and the cotton cultivable area was decreased once again in that year. From there on the area under cotton cultivation steadily continued to increase.

Figure 4.7: Area vs. Market and Support Prices for Cotton Crop in Sindh from 1985-2015



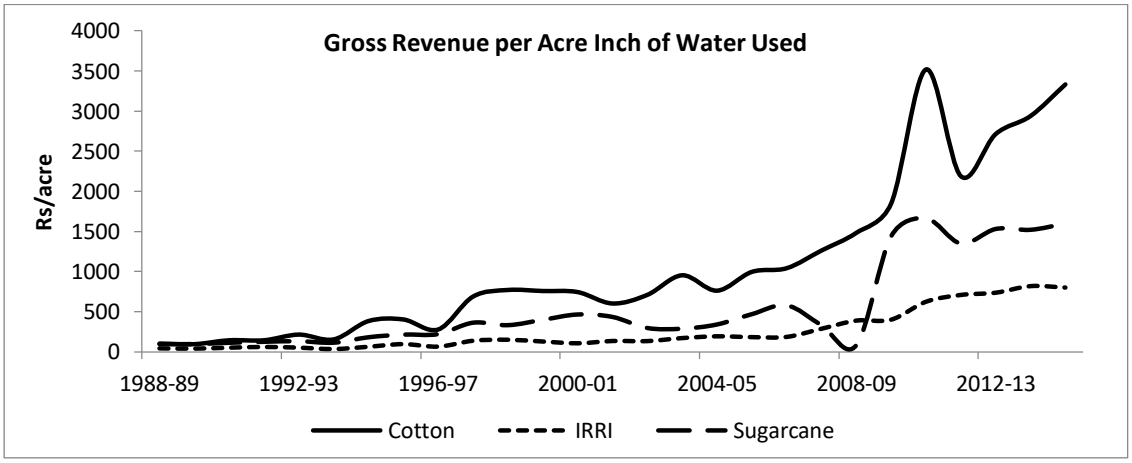
Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

Although the area under cotton remained above the trend line, a slight fall in area was observed in 2003-04. Comparing the areas of other competing crops of the season, it can be seen that the reduction in cotton area was felt because the area of other crops responded more positively than cotton to the increase in overall cultivated land. From there on, the area graph remained a steady uphill climb until the floods in 2010-11 which drastically reduced the area of cotton crop. The effects of the floods were felt till the next year after which the area regained its strength and continued to increase from 2012-13 onwards.

4.1.5 Farmer's Profitability and Water Use:

Cotton cultivation has been continuously on the rise regardless of slight fluctuations in the domestic market and support prices. The demand for this crop mainly stems from the textile industry, which is the largest industry of the country. Regardless of the socio-economic or political situation, textile industry never goes out of demand. Thus, farmers prefer this crop due to high domestic demand and reasonable profit margins in comparison with other competing crops of the season. They do not find a suitable alternative for cotton in terms of return for their investment or even water usage as it offers the best values in comparison with all other alternatives for the season, as seen in Figure 4.8.

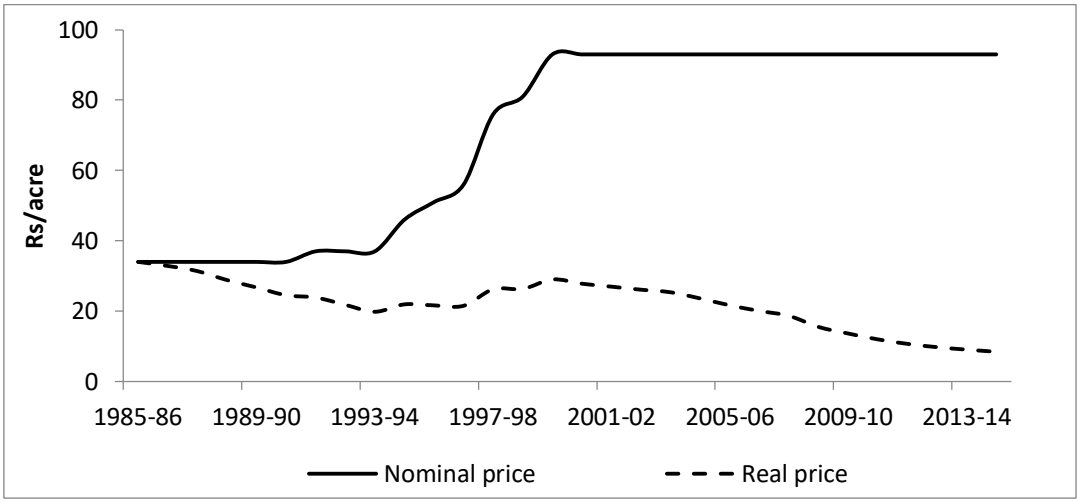
Figure 4.8: Gross Revenue per Acre Inch of Water Used for Cotton in Sindh, 1988-2015



Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

In terms of water requirement, total water required for this crop is 28-51 inches per total growing period. The water rate or Aabyana was decided at Rs 34 in 1980-81, which was later increased to Rs 93 in 1999-00 and has remained at that level which can be seen in Figure 10. However, this can be considered as the nominal water price, which, after CPI adjustment, is much higher than the actual price paid by the farmers (Figure 4.9). Thus, water pricing has failed as a tool for water conservation or revenue generation rendering the farmers carefree from paying any *Aabyana* to the government

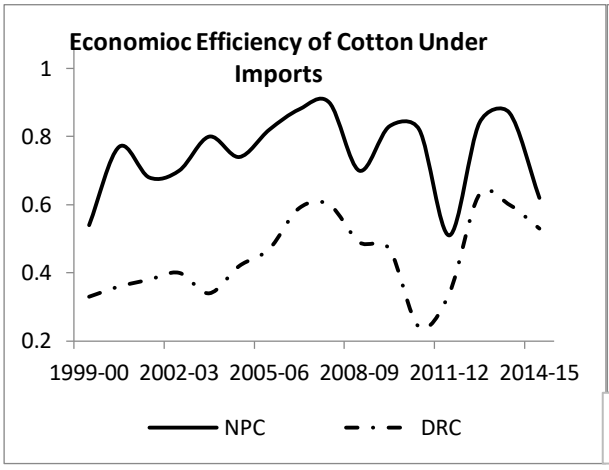
Figure 4.9: Water Prices for Cotton in Sindh; 1980-2015

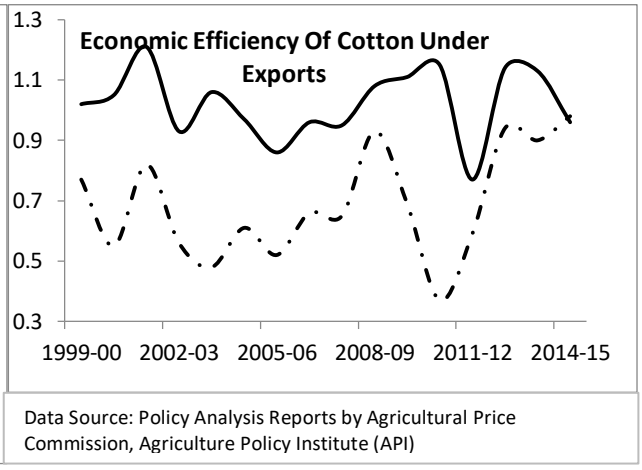


Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

In terms of economic efficiency, NPC and DRC values are analysed for both export and import scenarios. The graphs for these values have been given in Figure 4.10.

Figure 4.10: Economic Efficiency of Cotton in Sindh from 2000-2015





Data Source: Policy Analysis Reports by Agricultural Price Commission, Agriculture Policy Institute (API)

Under import parity prices, the economic efficiency values of NPC remained closer to 1 but did not achieve the break-even price. This implies that the cotton farmers have enjoyed no economic protection from the government in the form of support prices or stable domestic market prices. The farmers have also been implicitly taxed by the government. The DRC values also remained <1 which indicates surplus potential in the cotton industry which needs to be properly developed. It will be wise to invest in resources for domestic cotton production rather than importing it by losing foreign exchange.

4.1.6 OLS Regression Results:

Table 4.2: Regression results for Cotton in Sindh

R Square	0.38
Adjusted R Square	0.28
Observations	30

Variables	Coefficients	t Statistics	P value
PDC_1	91.35	2.08	0.047**
PU	-1.049	-1.51	0.143
PDAP	0.245	1.28	0.209
CWW	78.979	4.47	0.000***

Note: P values are given at 1%, 5% and 10 % by denoting ***, **, * respectively.

Table 4.2 explains the changes in cotton area (explained variable) due to changes in its explanatory variables i.e. Price difference of cotton, Canal water withdrawal and Prices of Urea and DAP). The model is statistically fit with f-test value nearly equal to 4 and R^2 of 38 %.Total number of observations is 30.

The results show that the price difference ratio of market and support prices of cotton is positively significant with cotton area. Canal water withdrawal plays a significantly positive role in determining area under cotton cultivation. 1 million acre-feet increase in canal water withdrawal leads to increase cotton crop area by 22 thousand acres. On the contrary, prices of fertilizers do not play a significant role in determining area under cotton cultivation. Price of urea shares a negative relation with cotton area whereas one unit increase in price of urea negatively affects the cotton area by 1 thousand acres. However, these results lose their meaning by being insignificant.

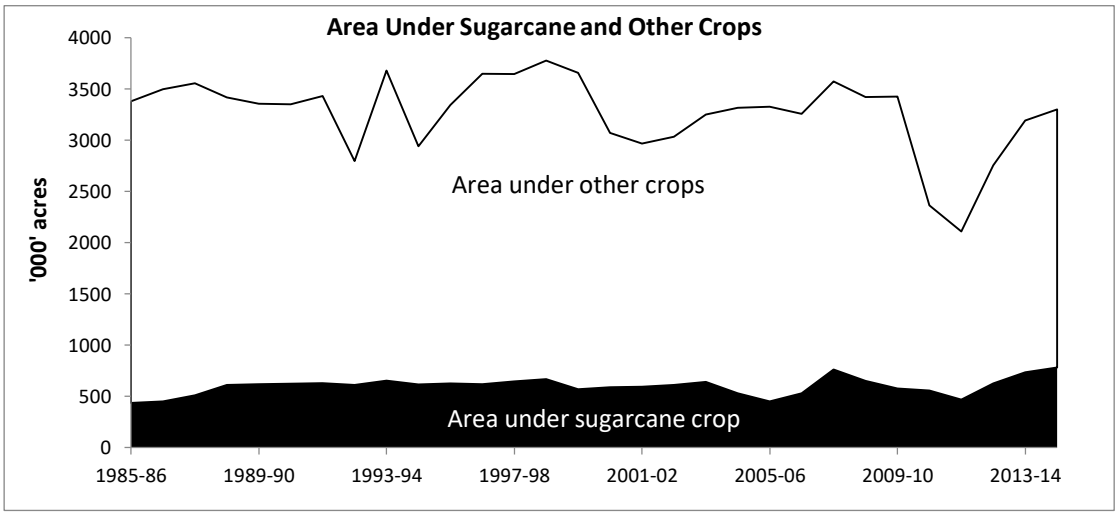
Section III: Sugarcane

4.2 Cropping Pattern

Sugarcane is the second largest non-food grain after cotton and the second largest industry after textile in Pakistan. It is cultivated on 18 per cent of the total cultivated land (2014-15), of which 12 per cent is in Sindh province. It adds 3.2 and 0.7 per cent to the value added in agriculture and GDP respectively Sugarcane is mainly grown for manufacturing sugar and other sweeteners (Shakkar and Gur) and its by-products are used in chipboard and paper industries. It is an important source of income and employment for the farming community also. Currently, there are 91 sugar mills in the country with a distribution of 48 mills in Punjab, 34 in Sindh and 9 in NWFP province. These mills crush nearly 78% of total sugarcane produced in the country to produce 3.82 million tons of white sugar (Bux Peerzado et al., 2016). Besides, sugarcane farming and sugar manufacturing contribute significantly to the national exchequer in the form of various taxes and levies. However, due to persistent rise in input prices and cost of production, farmers are discouraged to invest any further in this crop. On a national level, area and production under sugarcane has remained stagnant and somewhat decreased, as farmers are considering other options like sunflower, maize and potatoes.

A time series analysis of the area of sugarcane crop in Sindh is carried out in Figure 4.11 with the aim to understanding the cropping pattern and its associated reasons.

Figure 4.11: Time series analysis of cropping pattern of Sugarcane; 1985-2015



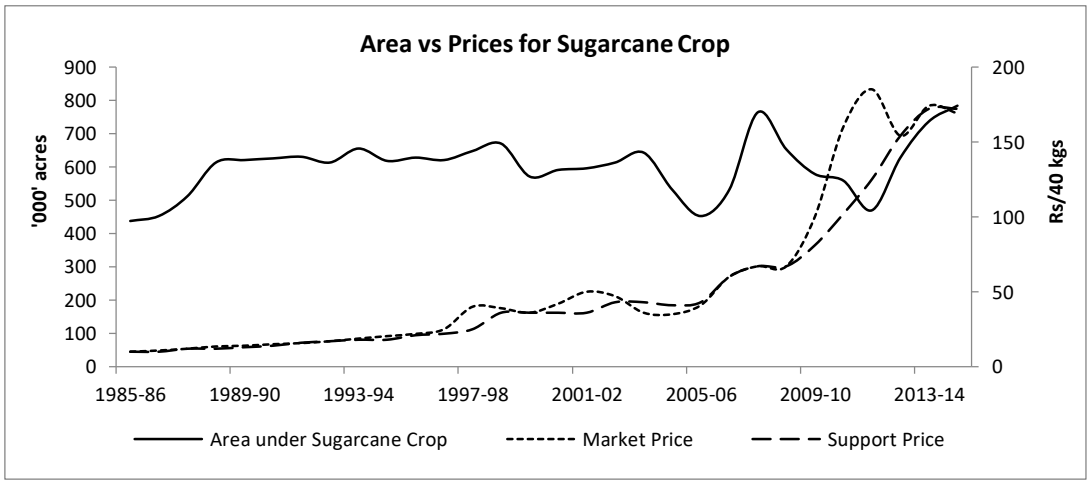
Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

A glimpse at the above Figure 4.11 indicates a nearly stagnant trend line for sugarcane area with very slight increase over the past three decades. Figure 4.11 shows a jump in area in 1987-88 where area increased from a steady 0.45 million acres to 0.51 accounting for 12 per cent increase in area over the past years. This was due to the sudden increase in indicative prices of sugarcane from Rs8.3 to Rs15.8 per 40 kg. Additionally, this increase was warmly welcomed by the farmers due to same cost of production as the last year for which the profit margin of farmers increased greatly. After this, the trend for sugarcane area in Sindh remained stable for the next couple of years. The next increase in cultivated area was found in 1993-94 after an increase of 42000 acres in the total cultivated area. This is mainly due to low cost of major inputs which decreased at Rs7 per ton of sugar produced.

A slight dent in the area was found in the year 1999-00 as it reached a low of 0.57 million acres. Although the market prices raised by Rs 8 per 40 kg but in real terms the market price declined by 2 per cent whereas the cost of production increased by Rs 22.5 per 40 kg for both farm level and mil gate, expressed in Figure 4.12. From

here the area started recovering in 2002-03 and reached a peak in 2003-04 at an area of 0.64 million acres. This positive change has been attributed to economic as well as climatic factors. Better prices were offered by the mill owners for cane procurement from the farmers. Along with this, timely rains and better production prospects by positive BCR values of fertilizer use encouraged the farmers to increase area over time.

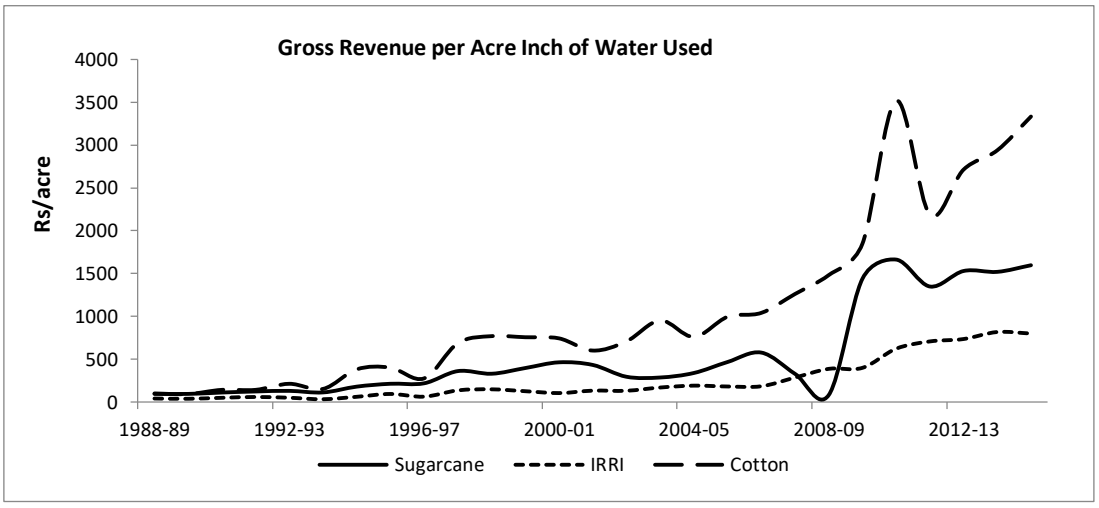
Figure 4.12: Area vs. Market and Support Prices for Sugarcane in Sindh from 1985-2015



Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

However, these improvements were reversed the next year as area decreased 111000 acres in 2004-05 and a further 79000 acres in 2005-06. This was the lowest area value of 0.45 million acres that the crop had seen since 1986-87. This was mainly due to the persistently low sugar prices in the domestic and international markets. The farmers had been suffering losses due to increased costs of production and low returns. Thus, to avoid further loss, area under sugarcane was decreased by the farmers who opted to substitute the crop with cotton, IRRI paddy and other crops which promised better returns in terms of inputs and gross revenue per acre inch of water used (Figure 4.13)

Figure 4.13: Gross Revenue per Acre Inch of Water Used for Sugarcane, 1988-2015



Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

All this resulted in low production figures which forced international market to increase prices, resulting in better domestic market prices for sugarcane and sugar. Thus high prices were offered by the mill owners to the sugarcane growers for 2005-06 crops. Anticipating the same trend, the farmers increased the area under sugarcane cultivation in 2006-07. However, increased production and declining prices prevented the market to increase prices. Unaffected, farmers continued increasing the acreage under sugarcane until it reached an all-time high of 0.76 million acres in 2007-08. Yet it did not garner the appreciation, in terms of increased market price, that the farmers had expected and they had to suffer huge losses for the 2007-08 bumper crop.

This led to falling area under sugarcane as farmers looked for other profitable options like cotton, maize, sunflower, onions, vegetables and fruits. Cultivated area again hit a low of 0.46 million acres in 2011-12. Thus a decline of 0.3 million acres was felt in just 5 years. Of late there had been a confrontation between growers and millers over prices in which the millers seemed better off from their exchange. Cane growers have been continuously deprived off their just prices and forced to sell their produce for

low prices or the alternative is rotten crops. Still, a rise in the area was seen in 2012-13 as it improved by 20 per cent (0.15 million acres) and continued to a further 10 per cent in 2013-14 (0.10 million acres) in 2013-14. This was accredited to declining international market prices of sugar which made sugar export impractical and, in turn, stabilised the domestic market prices. Farmers' confidence in the crop was further boosted by stable input prices for sugarcane production which remained at Rs358 per ton since 2013-14.

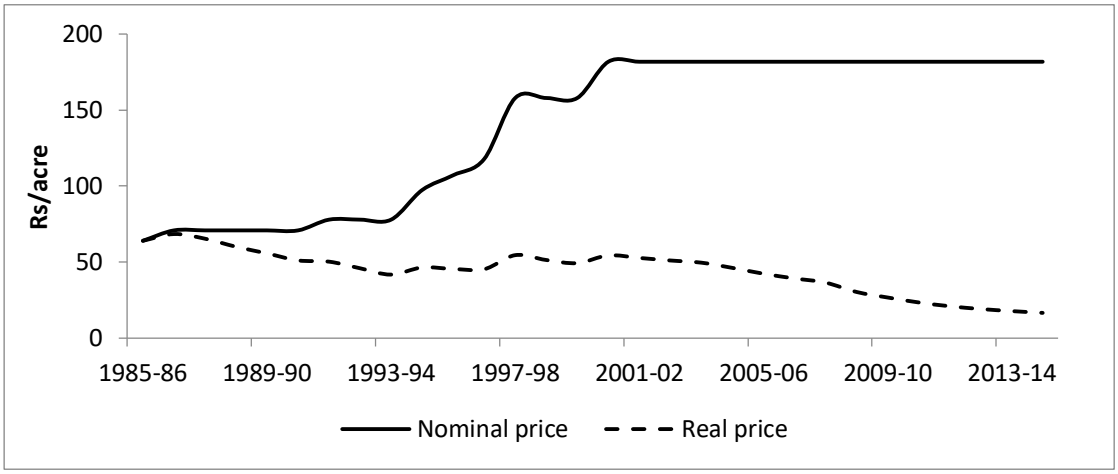
Although not much area has been added to the sugarcane crop over the past three decades, yet it remains as one of the top cash crops of the country. There are many discouraging factors in this crop's cultivation, like unstable market prices, increased cost of inputs, non-implementation of indicative/support prices, lack of timely payments and water scarcity etc. Still, farmers prefer to cultivate this crop. An interview conducted with Mr Hussain*, who is a farmer in district Thatta, revealed that the primary reason behind sugarcane's continued cultivation is the crop's high yield coupled with long crop duration (3-5 years) and better profit margins at different stages of the crop's lifecycle. Other seasonal crops offer limited work-time. This implies a fixed profit at the end of the crop's cycle, after approximately 6 months. However, sugarcane offers more chances of profit because it is harvested multiple times in the same crop cycle. Another reason is that sugarcane is a political crop in Pakistan as nearly all the sugar mills are owned by influential politicians. This factor has the capacity to single handily turn the tables in favour of sugarcane cultivation.

4.2.1 Farmer's Profitability and Water Use:

In terms of water, the average amount of water required for sugarcane is 48 acre-inches per crop duration. The nominal water rate or *Aabyana* for sugarcane was Rs 64 in 1985-86 and steadily kept on increasing to Rs 182 in 2000-01 and has remained

stagnant form then on. It can be seen in Figure 4.14. However, after CPI or inflation adjustment, the real water rates paint a completely different picture. As for cotton and rice, it remains true here also that water is treated as a public good by the farmers and no water price is paid to the government. The water recovery rate is also extremely low as no officials from the irrigation department visit for survey, either before setting water price or at sowing time.

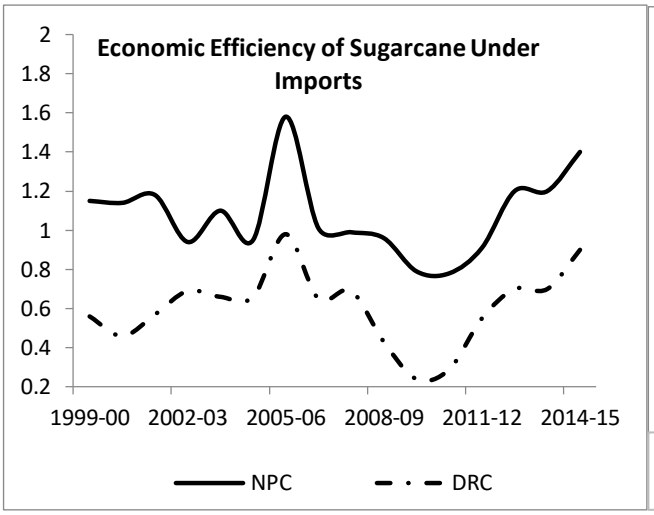
Figure 4.14: Water Price for Sugarcane in Sindh: 1985-2015

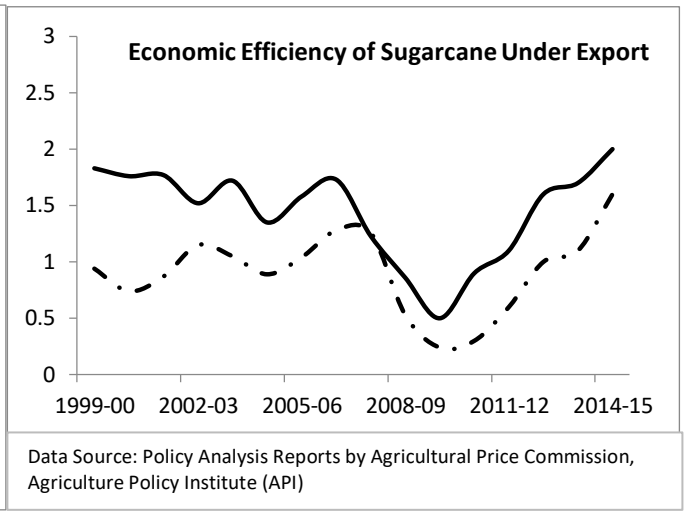


Source: Policy Report Analysis by Agricultural Price Commission, Agriculture Policy Institute (API)

For evaluating the economic efficiency of the crop, NPC and DRC values are studied, under both import and export parity prices. From Figure 4.15, it can be seen that under import scenario, NPC values have remained above the break-even point, other than a couple of years. It means that the local producers are economically protected by the government in the form of stable market prices and indicative prices. On the contrary, DRC values have been <1 indicating comparative advantage in local sugar production as opposed to sugar import.

Figure 4.15: Economic Efficiency of Sugarcane in Sindh; 1999-2015





Data Source: Policy Analysis Reports by Agricultural Price Commission, Agriculture Policy Institute (API)

Under export scenario, the NPC and EPC values have been >1 indicating government protection to the local producers. In addition, no implicit taxes were implied on the producers. On the other hand, the DRC values have been more than or equal to 1 in majority of the years. This shows that Pakistan suffers from a comparative disadvantage in sugar production where importing sugar is a viable option than producing it locally. This is mainly due to fluctuating market prices which kept on decreasing the area and production levels of the country.

4.2.2 OLS Regression Results:

Table 4.3: Regression results for Sugarcane in Sindh

R Square	0.42
Adjusted R Square	0.30
Observations	30

Variables	Coefficients	t Statistics	P Value
MPS_1	-2.406	-1.02	0.316
SPS_1	5.435	2.81	0.010***
MPC_1	0.006	0.18	0.859
MPI_1	-0.296	-1.64	0.113
PU	-0.147	-0.36	0.715
PDAP	0.068	0.75	0.459
CWW	76.053	3.64	0.001***

Note: P values are given at 1%, 5% and 10 % by denoting ***, **, * respectively.

Table 4.3 investigates the relationship between sugarcane area and its explanatory variables i.e. Market price of sugarcane, Support price of sugarcane, Market price of cotton, Market price of IRRI and Canal water withdrawal. F-test for the model stands at 3.5 while the R^2 value is 42%.

It can be seen from Table 4.3 that the market price for sugarcane negatively impacts the area under cane cultivation. However this relationship is insignificant. On the contrary, support or indicative prices for sugarcane have a significantly positive relationship with sugarcane area. Market price of cotton shows insignificant positive relation with sugarcane area while market price of IRRI negatively impacts sugarcane area. Since cotton and sugarcane do not share the same districts for crop cultivation, these results do not offer any insight. However, negative effect of IRRI market price indicates that the farmer has a choice between sugarcane and rice cultivation based on better prospective market prices. Price of urea negatively impacts sugarcane area while DAP price has a minute positive impact on sugarcane area, but the results are not significant. Apart from this, canal water withdrawal positively impacts sugarcane area such that 1 million acre-feet increase in canal water results in 76 thousand acres increase in sugarcane area.

Section IV: Labour Division and Gender Roles in Sindh Agriculture

Through ages, agriculture has been the primary occupation that has seen participation from both male and female members of the society. The same is the case for Pakistan where women from the agricultural families work alongside their male relatives in farms. Particularly in Sindh, women from tenant families or *haries* work equally with their males in the fields (Khan et al., 2012). According to an article published in 2018, nearly 67% of Pakistani women are associated with agriculture (Pakissan, 2018).

In order to estimate the on ground situation of gender division in Sindh province of Pakistan, a set of agricultural policy reports issued by the Agricultural Policy Institute (API) have been critically analysed along with interviews conducted from farmers/farm owners in different districts of Sindh. Time series data from 1985-2015 has been collected (see Appendix) and verified by both these sources on male-female participation rate in various activities involved in the cultivation of particular crops i.e. cotton, rice and sugarcane as shown in Table 4.4. From this data we can estimate the gender participation during the cultivation of particular crops.

Table 4.4: Gender Participation in Various Cultivation Related Activities for Particular Crops

Gender	Activities	Percentage division of labour
Male	Land preparation, Seed bed preparation, Sowing, Field irrigation, Plant protection, Interculture, Harvesting, Loading trucks	Cotton = 61% Rice = 54% Sugarcane = 66%
Female	Stripping seeds, Seed transplantation, Sowing, Field irrigation, Harvesting	Cotton = 39% Rice = 46% Sugarcane = 34%

Source: Agriculture Policy Reports published by Agriculture Price Commission, API

From Table 4.4 we can see that nearly 60% of the labour work involved in a single crop cultivation for the particular crops is done by males, whereas, 39% of the manual labour is provided by females. These results have been generated by generalizing the results obtained through various interviews and correlating them with the policies as the agricultural policies alone have been silent on this matter. The policies in nature are gender insensitive and do not focus upon issues such as labour wages, social and economic characterters of the labour or labour based incentives. Thus, it can be safely assumed that the government neither directly nor indirectly plays any part in the labour demographics of the agricultural sector.

Although the results of labour division have been taken as average of the data from past 30 years, the trends in male-female participation rate can be seen as decreasing for both rice and sugarcane whereas it has increased in case of cotton. A telephonic interview conducted from a farm owner from interior Sindh revelaed that the rate of labour availability is not a problem as a lot of people from the villages are associated with agriculture. However the labour working on the fileds is nearly equal for both male and female participation. For all three crops, i.e. cotton, rice and sugarcane, more laborous work such as land preparation is done by males however all the rest of the work is either done by both the genders or by females alone. There is 50-50 participation rate in terms of sowing and harvesting of sugarcane, whereas in case of rice sowing, all the work is done by females as they are better at it than men. Similarly in case of harvesting the fields, both males and females work equally for rice and sugarcane crop. The in-between works such as field irrigation and spraying fertilizers and pesticides is done by both males and females depending upon the areas. In an interview from district Thatta, a farm owner revealed that it is the femlaes now who do most of the work while the men are either sitting around or wandering

aimlesly. Women are more actively involved in agricultural activities as compared to before.

In all the interviews it was found that the labour wage rate per acre of work is not gender biased. Same wages are paid for both male and female workers. Different groups of male and female labour work on a single acre of cultivated land. On the face of it, this seems like a fair treatment of labour, however, the farm owners revealed that the wages are not paid separately to all the labours but they are paid to the male heads of the groups working on separate acres of land. It is not certain how the wages are then passed on to the group members or if there is any discrimination between male/female labour by the group head or not. Thus it can only be assumed that the wages are paid equally to both male and female farm workers.

One of the many reasons for decreasing female labour rate is the mechanization of cultivation process. Interviews revealed that the process of ploughing was earlier done by bullocks which is now carried out by tractors. Similarly, harvesting and threshing machines have reduced the use of manual labour by a great percentage in case of wheat and rice. Seed sowing machines are also in use for wheat and cotton. Same is the case with fertilizer spraying machines. The widespread use of these machines are effective in terms of time management and low labour cost, but they are the leading cause of decresaed female labour rate. In a conservative setting like Sindh, it is not common practice to see a female operating a farm machine, rather it is inherently considered as a male occupation. This has lead to discourage the female participation rate as they are not needed in the fields for these purposes. In some cases, machines do not give better results, such as sowing of seeds in rice, cotton picking and sugarcane harvesting are all manual labour work. Particularly, rice seed sowing and cotton picking are purely female labour work as females are more skilled in them.

After mechanization, introduction of new chemicals has also lead to a decrease in the economic well being of female farm workers. Since one of the major activities of females in the rural setting is cattle farming, nearly every household in a village owns one or more cattle-s. Even those families that cannot afford to buy a cattle borrow it from someone else on *hissa* basis. This means that the lender will either get a share from the daily milk production or when the animal births a yound one, it will be under the ownership of the lender, not the borrower. The females get the milk from these cattles and make various milk based products such as *ghee* and yougart. Milk and its products are then sold in the local market. This serves as a source of extra income

Chapter V

CONCLUSION AND POLICY RECOMMENDATION

5.1 Conclusion:

This study has been carried out to analyze the cropping pattern of three main *Kharif* season crops i.e. cotton, rice and sugarcane in Sindh, Pakistan. Along with this water and gender nexus and farmer's profitability has been studied to identify their role in cropping choices of *Kharif* crops in Sindh. For this purpose, latent content analysis of time series secondary data has been done from 1985-2015. The data mainly contained agriculture policy documents obtained from Agriculture Policy Institute (API) along with other federal and provincial level agricultural notifications and SROs. Along with this, simple OLS model has also been applied to statistically check the relationship between crop acreage and its possible factors.

The study reveals that the cropping pattern of particular crops i.e. cotton, rice and sugarcane in Sindh has generally been on an upward trend since 1985. The area under these crops did suffer some highs and lows, but these were mainly due to price fluctuations in the market or very rarely, better cropping opportunities in the form of competing crops. Some natural disasters like floods, droughts and disease have also played their part in the area decrease but it has not been seen often.

It is generally perceived that cotton, rice and sugarcane are all water intensive crops so the current water shortage may negatively impact the area and production of these crops. However, it is seen that both IRRI rice and sugarcane show negative results with increased water availability, indicating that they are not as water consuming in reality. Only cotton crop showed positive results for increased water availability which proves that cotton is actually a water intensive crop while both rice and sugarcane can sustain water shortage. Another problem with water security is water

prices or *Aabyana*. Water prices for all crops in different provinces have been set by the concerned authorities; however there has been no revision in the prices since 2000 while the demand has increased manifold in the past two decades. Coupled along is the issue of water price recovery rate which is very low, making water nearly free commodity for all.

The government issued agriculture policy documents have been gender insensitive with regards to labor division, wage disparity, work load or socioeconomic well-being of farm workers. There has been no direct or indirect mention of gender in the documents, neither any relief has been offered that can benefit the farm workers, especially females. Labor division in crop cultivation has been done on the basis of interviews with farmers in different districts of Sindh province. From there, percentage wages can be extracted which can give the closest clue to female farm workers socioeconomic well-being. Apart from this, introduction of new technology in the form of better chemicals and machinery has added a cut on the female farm worker's income.

5.2 Policy Recommendation

Keeping in mind the purpose and findings of the research, following policy recommendations are suggested for the concerned government authorities:

- Out of all the variables that affect cropping pattern of the particular crops, market and support prices have the major effect. Government should devise applicable monetary prices which offer suitable rates to the farmers so that they can sell their produce at better profit margins. This would aim to improve the economic well-being of the farm workers.
- Farmers of these particular crops are more often compelled to sow these crops, even in low profit margins, because of lack of actual alternative crops.

Research and extension programs should be devised to come up with better options for the farmers so that they can exercise their free will in crop cultivation.

- The real water prices have been decreasing since past two decades which has essentially made water a free commodity. Governmental agricultural authorities should devise and implement new water prices for each crop and the recovery of those water prices should be made compulsory by the concerned authorities. In this way, water conservation can be made effective.
- The government policies have been gender insensitive throughout the years. Policies should be more gender inclusive and proper wages should be set for farm workers. Also, wages should be given directly to the workers rather than to the male head of group working on an area. In this way it can be ensured that all the employees are getting paid for their work.
- The female farm workers have suffered economically due to the introduction of new and improved technology, like farm machinery and chemicals. With the introduction of technology, government should also focus on relief programs for the female farm workers or they should be included in the mechanized farm work along with male farm workers. Also, they should be compensated for their economic loss by equal or alternative work opportunities.

5.3 Limitations of the Study

As the present study is limited in its choice of data source and variable selection, not every aspect of the unique phenomenon under observation could be analyzed. This leaves space for future research where information avenues can be further explored and better understanding can be established regarding the issues around us.

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APPENDIX

Gendered Wage Distribution in Particular Crops

Years	IRRI		Cotton		Sugarcane	
	Male%	Female%	Male%	Female%	Male%	Female%
1985-86	53	47	65	35	59	41
1986-87	52	48	65	35	59	41
1987-88	52	48	65	35	61	39
1988-89	51	49	66	34	61	39
1989-90	51	49	66	34	61	39
1990-91	50	50	65	35	61	39
1991-92	50	50	64	36	64	36
1992-93	47	53	61	39	64	36
1993-94	48	52	60	40	64	36
1994-95	48	52	63	37	64	36
1995-96	45	55	63	37	67	33
1996-97	47	53	60	40	67	33
1997-98	56	44	66	34	67	33
1998-99	55	45	63	37	67	33
1999-00	57	43	62	38	67	33
2000-01	58	42	61	39	67	33
2001-02	56	44	59	41	67	33
2002-03	56	44	57	43	66	34
2003-04	57	43	58	42	65	35
2004-05	56	44	62	38	65	35
2005-06	54	46	63	37	65	35
2006-07	57	43	64	36	65	35
2007-08	57	43	64	36	67	33
2008-09	56	44	62	38	67	33
2009-10	57	43	60	40	67	33
2010-11	58	42	61	39	61	30
2011-12	56	44	57	43	67	33
2012-13	59	41	53	47	68	32
2013-14	58	42	54	46	70	30
2014-15	60	40	52	48	71	29