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Discovering Thoughts, Inventing Future

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Development of Phytochemical Rich Ice Cream Incorporating Kinnow Peel

By Simran Mann & K S Minhas Poonam Aggarwal
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Abstract - The present study was carried out to develop ice cream using frozen Kinnow peel; both unblanched and blanched, at the levels of 1, 3 and 5%, each. The ice cream samples were analyzed for sensory and chemical parameters. The addition of Kinnow peel improved the appearance, flavour and overall acceptability of the ice cream samples. The total solids (TS), ascorbic acid and flavonoids (naringin) content of the ice cream samples were found to increase with increased level of addition of peel. Based on sensory evaluation, the best levels of frozen Kinnow peel in ice cream were: unblanched-3% and blanched-5%. When compared, ice cream with 3% unblanched-frozen kinnow peel was found to be the best.

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Development of Phytochemical Rich Ice Cream Incorporating Kinnow Peel

Simran Mann [α] & K S Minhas Poonam Aggarwal [σ]

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I. Practical Applications

This research would have practical applications in the ice-cream industry in terms of providing added value for an otherwise overlooked by-product of kinnow juice industry. The peel of the fruit, which is generally considered a waste is more nutritious than juice can be processed into candies that may be further used in the baking industry in the preparation of cakes, cookies, steamed puddings, sweet breads, mixed candied fruits and in marmalades. (Mehta and Bajaj 1984)

II. Introduction

Ice-cream is a leading product in the global market among innovative dairy products, as consumers increasingly associate the segment as being more of an everyday, year-round household grocery (Soukoulis *et al* 2009). It is considered as a food of high nutritional and caloric density, but poor in dietary fibers and some of the natural antioxidants. Nowadays, the consumers' trends has been towards foods with more natural antioxidants, dietary fibers, natural colourants, minerals, vitamins, low calories, low cholesterol and low fat and free of synthetic additives, etc. (El-Samahy *et al* 2009).

Citrus possess many beneficial components that are located in the parts that most consumers would throw away. The amount of residue obtained from citrus fruits, account for 50% of the original amount of whole fruit. Citrus fruits are mainly used for juice, oil and pectin production and are under utilized sources for dietary fibre and antioxidants (Nassar *et al* 2008). The industry of fruit juices produces significant amounts of by-products which could cause problems in their disposal.

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In citrus fruits, about three-fourth of the vitamin C is present in the peel, pulp and seed, that goes waste (Nagy 1980). As an antioxidant, vitamin C can protect LDL cholesterol from oxidation to help reduce the incidence of heart disease and can also block the formation of carcinogenic nitrosamines in the body (www.foodproductdesign.com). Citrus peel is also an interesting source of phenolic compounds which include phenolic acids and flavonoids. The citrus flavonoids which include Hesperidin and Naringin, have been found to have antioxidant as well as other health related properties like anticancer, antiviral and anti-inflammatory activities, etc. (Bocco *et al* 1998).

Kinnow mandarin (*Citrus reticulata),* a hybrid of King & Willow leaf, is one such citrus fruit with a production of 4,14,090 tonnes in Punjab (Anon 2007). While processing, it yields 50 percent juice, 25 percent peel, 23 percent residue and 2 percent seeds (Aggarwal and Sandhu 2006). These figures clearly show that a major portion of the fruit is going waste during processing, which can be utilized for many value added products. On an average, Kinnow peel contains 22.45 percent total solids, 12.500 B TSS, 1.38 percent acidity, 41.57 mg/100g ascorbic acid, 6.23 percent total sugars, 5.99 percent reducing sugars, 0.67 percent ash, 13.65 mg/100g carotenoids, 7.43 mg/100g β-carotene, 1.85 percent pectin & 0.77 percent fat (Aggarwal & Sandhu 2003). It also contains naringin (0.420 mg/g, approx) and limonin (4.69 mg/g approx) (Premi *et al* 1994).

Keeping in view the increasing demand of ice cream and increased consumer awareness about healthier eating habits, this research project was designed to develop phytochemical rich ice cream incorporating Kinnow peel and studying the chemical and sensory characteristics of the final product.

III. Material and Mathods

a) Preparation of different forms of Kinnow peel

Kinnow peels were washed and white portion (albedo) was removed from inside the peels. The cleaned peels were then cut into shreds and were used for the preparation of frozen Kinnow peels i.e.

Unblanched-frozen Kinnow peel – Kinnow peel shreds were packed in polyethylene pouches and frozen at -18°C.

Blanched-frozen Kinnow peel – Kinnow peel shreds were kept in boiling water for 4 mins, air-dried, packed in polyethylene pouches and frozen at -18°C.

These forms were added to ice cream at the levels of 1, 3 and 5%, each.

b) Preparation of ice cream

A plain ice cream mix having a composition of fat 10%, SNF 11%, sugar 15%, stabilizer 0.3% and emulsifier 0.1% was prepared using buffalo milk, cream, skim milk powder, sugar, sodium alginate and glycerol monostearate (GMS). The mix ingredients were calculated using the formula given by Arbuckle (1977). The prepared ice cream samples were stored at -18 to -20°C.

c) Chemical and sensory evaluation

Ice cream samples were analysed for chemical and sensory quality. Total solids and ascorbic acid were estimated according to AOAC methods (2000). Flavonoids (naringin) were determined by the Davis method (Ting and Rouseff 1986). Sensory evaluation was carried out using 9-point hedonic scale. The results obtained were statistically analysed with the help of CRD using the software CPCS-1 (Singh et al 1991).

IV. Results and Discussion

The data obtained for the effect of addition of different levels of unblanched frozen Kinnow peel on the mean sensory scores of ice cream is given in Table 1. It can be seen that as the level of peel increased from 1 to 5%, the appearance scores also increased significantly from 7.9 to 8.6, due to increased intensity of natural orange colour in the ice cream. The taste scores also differed significantly among all the samples, the highest being ice cream with 3% unblanched frozen Kinnow peel (8.2), as bitterness could be perceived at 5% level. The aroma scores (8.2) were higher for both the ice creams with 3 and 5% Kinnow peel. Non-significant difference was observed for the body and texture scores of all ice cream samples. Overall acceptability scores (8.1) were significantly higher for ice cream with 3% Kinnow peel.

Table 1 : Effect of Addition of Different Levels of Unblanched-Frozen Kinnow Peel on the Mean Sensory Score of Ice Cream

Level (%)	Appea -rance	Flavour		Body & texture	Overall accept -ability
		Taste	Aroma		
0	7.3	7.2	7.1	8.0	7.0
1	7.9	7.7	7.8	8.1	7.8
3	8.2	8.2	8.2	8.0	8.1
5	8.6	7.9	8.2	7.9	7.9
LSD(p <0.05)	0.3	0.3	0.3	0.0	0.3

The effect of addition of different levels of blanched-frozen Kinnow peel on the mean sensory scores of ice cream is shown in Table 2. The appearance scores increased significantly from 7.4 to 8.4 for all the ice cream samples as the level of peel addition in ice cream increased from 1 to 5%. This could be attributed to an increased intensity of natural orange colour in the ice cream samples with increasing level of peel. The taste (8.3) and aroma (8.4) scores were found to be significantly higher for ice cream with 5% blanched-frozen Kinnow peel as the heat treatment given to the peels decreased their bitterness due to which a higher percentage of these peels was found to be acceptable in ice cream. The body and texture scores (8.2) were significantly higher for ice cream with 3% peel. Overall acceptability scores (8.4) were higher for ice cream with 5% peel but in close proximity to the sample with 3% peel (8.3).

Table 2 : Effect of Addition of Different Levels of Blanched-Frozen Kinnow Peel on the Mean Sensory Score of Ice Cream

Level (%)	Appea -rance	Flavour		Body & texture	Overall ace- ptability
		Taste	Aroma		
0	7.2	6.9	6.7	7.6	7.1
1	7.4	7.9	7.9	7.9	7.7
3	8.1	8.1	8.3	8.2	8.3
5	8.4	8.3	8.4	8.0	8.4
LSD (p<0. 05)	0.3	0.3	0.3	0.3	0.3

The chemical analysis of ice cream containing different levels of unblanched and blanched frozen Kinnow peel is given in Table 3. The total solids (TS) content of ice cream with unblanched-frozen Kinnow peel ranged from 36.8 to 37.7% and for ice cream with blanched-frozen Kinnow peel from 36.7 to 37.4%, as the levels increased from 1 to 5%. Ascorbic acid and flavonoids (naringin) content of both types of ice cream increased with increasing level of addition of peel. Ascorbic acid content increased from 3.7 to 6.0 mg/100g for ice cream with unblanched-frozen Kinnow peel and from 2.9 to 5.1 mg/100g for ice cream with blanched-frozen Kinnow peel, as the level of addition increased from 1 to 5%. Similarly, as the level of addition of peel increased from 1 to 5%, the flavonoids (naringin) content also increased from 63.3 to 81.1 μg/g for ice cream with unblanched peel and 46.6 to 74.4 μg/g for ice cream with blanched-frozen Kinnow peel.

Table 3 : Chemical Analysis of Ice Cream Containing Different Levels of Unblanched and Blanched Frozen Kinnow Peel

Kinnow peel form	Level (%)	Total solids (%)	Ascorbi c acid (mg/100 g)	Flavonoi ds asnar ingin(μg/ g)
Unblanche	1	36.8	3.7	63.3

d-frozen	3	37.2	5.4	78.3
	5	37.7	6.0	81.1
	LSD (p<0.05)	0.05	0.40	0.40
Blanched -frozen	1	36.7	2.9	46.6
	3	36.9	4.5	68.1
	5	37.4	5.1	74.4
	LSD (p<0.05)	0.03	0.40	0.40

When the ice creams with the best levels of unblanched (3%) and blanched (5%) frozen Kinnow peel were compared among themselves on the basis of their sensory characteristics (Table 4), it was observed that the ice cream with 3% unblanched-frozen Kinnow peel had better mean sensory scores with an overall acceptability score of 8.1.

Table 4 : Comparative effect of addition of unblanched and blanched-frozen kinnow peel on the mean sensory score of ice cream

Kinnow peel form	Appea -rance	Flavour		Body & texture	Overall accept ability
		Taste	Aroma		
Unblanc hed (3%)	8.3	8.0	8.2	8.0	8.1
Blanche d (5%)	7.9	8.1	8.0	7.8	7.8
LSD(p< 0.05)	0.2	0.0	0.0	0.0	0.2

V. Conclusion

The addition of frozen Kinnow peel (unblanched and blanched) to ice cream improved the appearance and flavour of ice cream, giving it a good natural orange colour and flavour. Both forms of frozen Kinnow peel were added to ice cream at the levels of 1, 3 and 5%, each. The TS, ascorbic acid and flavonoids (naringin) contents of both the ice cream types increased with increased level of peel addition. Based on sensory evaluation, the best levels of frozen Kinnow peel in ice cream were: unblanched – 3% and blanched – 5%. When compared, ice cream with 3% unblanched-frozen Kinnow peel was found to have better sensory scores than ice cream with 5% blanched peel. So, ice cream can be prepared by the addition of frozen Kinnow peel with improved colour, flavour and enriched with phytochemicals.

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Overcoming High Grain Moisture Content Prior to Storage in Poor Communities: The Case of Rungwe District, Tanzania

By Rose Mujila Mboya
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Abstract - A study was conducted on a sample of 260 randomly selected farm households in Katumba ward, Rungwe district, Tanzania in 2009. Farm households were interviewed regarding maize grain moisture content at harvest, the effectiveness of maize drying methods in use the proportions of maize they normally lost to storage pests. The availability of biogas and its feasibility for maize drying prior to storage were investigated through studying the potential for the types of latrines used in the study area to accumulate biogas. Maize samples from a sub-sample of 130 farm households were collected at harvest and studied for moisture content using a moisture content tester. Another set of 130 maize samples were collected from the same sub-sample households after five months of maize grain storage and studied for insect infestation using the incubation method. Findings showed that farm households dried maize in the sun or in the roofs. Moisture content of maize at harvest was high, and the drying methods in use were inadequate to dry it fast and thoroughly, thus encouraging the infestation of maize by pests. Also, all of the farm households used latrines that have capacity to accumulate biogas. Thus it was concluded that the maize drying methods were not efficient, that the use of biogas for maize drying was feasible, and that the latter could be the most suitable grain drying technology for the climatic conditions in Rungwe district.

Keywords : *moisture content, maize, drying methods.*

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Keywords : moisture content, maize, drying methods.

I. Introduction

Grain moisture content is the percentage of water contained in the grain (Hagan, 2012). There are different opinions concerning specific moisture contents at which maize can be stored safely. However, the general understanding is that maize which is harvested at moisture content higher than 12.5 % would require the use of driers to reduce moisture content to the appropriate percentage before storage (CBH Group, 2006). High moisture content in maize does not only encourage the development of moulds and insect pests, but it could also lead to the effectiveness of insecticides on the maize being reduced (CBH Group, 2006).

The exchange of moisture between stored maize and the storage environment until equilibrium is reached is also known to occur (Metananda, 2001; Abba and Lovato, 1999). Thus, the exposure of dry maize to moist air would lead to the intake of more moisture from the air by the maize. The opposite can also take place until the air in the storage facilities is saturated. In view of this, in humid places also characterized with low temperatures, maize which has high moisture content at harvest would require appropriate technologies to ensure adequate dryness of the maize grain prior to and during storage. For preventing the growth of moulds in maize which is not dry enough at harvest, Reed *et al.* (2007) and Semple *et al.* (1989) recommended rapid drying or up to 48 hours, respectively, depending on drying conditions.

a) Climatic Conditions in Rungwe District

Rungwe district is characterized by rainfall throughout the year ranging from an average of 900 mm in the lowland zone to 2,700 mm in the highland zone and cool temperatures ranging from 18 - 25 ^{0}C (Administrator, 2010). Temperature in this district may drop to a minimum of 10 ^{0}C during the cold season. The indicated climatic conditions suggest that grain may have high moisture content at harvest, and it raises questions regarding the effectiveness of grain drying methods that farm households use in this district to dry maize prior to storage. Furthermore, temperatures between 20 - 40 ^{0}C are known to be most favourable for the development and growth of moulds (FAO, 1985). Likewise, the development and growth of most of insect pests occur at 10 - 40 ^{0}C. Thus temperatures in Rungwe district are within the range in which moulds and insect pests can easily develop in the presence of moisture. Consequently, high moisture content of maize gain at harvest and the indicated climatic conditions that characterize Rungwe district would encourage the deterioration of stored maize.

b) Subsistence farm households' socio-economic status

In 2011 Mboya reported that a farm household which consisted of five people in Katumba ward, Rungwe district, Tanzania lived on TS 319.20 or USD 0.21 per day, while those made up of six people lived on TS 267 or USD 0.17 per day (Mboya, 2011). In general, farm households in Rungwe district lived below the World Bank's poverty line, which is USD 1.25 per individual (Crocodila, 2010), and there is no imperical evidence to suggest that the status quo has changed. This reveals a great deal of low income and poverty in this area. It also suggests that expensive technologies

are not convinient for the people in this area. This factor should be taken into consideration when introducing efficient grain drying technologies for improving subsistence farm households' storage output in this area. A suitable grain drying technology suitable for households with low income in a place characterized with wetness and prolonged rainfall such as Rungwe district should not only have the capacity to dry grain fast and thoroughly prior to storage, but it should also be affordable, durable and easy to manage.

c) The potential for bio - gas to be an effective source of fuel for subsistence farm households

Biogas is produced when organic matter decomposes anaerobically, that is in the absence of oxygen (Harris, 2010). It mainly consists of Methane (CH_4), and Carbon Dioxide (CO_2). However, depending on the source of its production, biogas may contain other gases such as Nitrogen (N_2), and Hydrogen Sulphide (H_2S) (Naskeo Environment, 2009). Moreover, biogas can be made from dead plants, sewage and from both animal and human waste products (Harris, 2010). It can be produced and used at household level, which is the case in many parts of Asia such as India and Nepal (Van Nes, 2006). Small scale units of biogas are said to be simple to build and operate (Harris, 2006). This makes the use of biogas cost effective, thus not only possible, but also beneficial and important for poor communities.

Pit latrines are known to be good sources of biogas (Buxton and Reed, 2010). Thus, in places where pit latrines are the norms, households could benefit in a number of ways, including: minimising fuel costs for domestic lighting and heating purpose and improving sanitation by burning it, thereby minimizing its accumulation in the environment. Most important for this paper is that farm households could harvest biogas for indoor rapid grain dying where climatic conditions make it difficult for grain to be dry enough for storage at harvest.

d) Hypotheses

1. \It was hypothesized that due to the climatic conditions in Rungwe district, farm households in this district could be facing difficulties in ensuring that maize is thoroughly dried prior to storage, which could encourage the development of pests in stored maize and to maize losses during storage.
2. It was also hypothesized that the use of biogas for grain drying in Rungwe district is feasible.

This study was conducted in order to test these hypotheses. Specifically, this study was conducted for the following objectives:

1. To investigate moisture content of maize at harvest and its association with maize loss to insect pests in Rungwe district, Tanzania,
2. To investigate the suitability of methods used for drying maize which is not dry enough at harvest and the length of time it takes for it to be dry enough for storage in Rungwe district, and
3. To explore the availability of sources of biogas and suggest the use of biogas for grain drying prior to storage in Rungwe district and other places with similar climatic conditions.

Due to financial constraints, coupled with the understanding that agricultural practices and climatic conditions in Rungwe district are the same, only one of the wards in this district, namely, Katumba ward was subjected to this investigation.

II. Materials and Methods

A sample of 260 farm households was randomly selected in Katumba ward using the procedure described by Mboya *et al.* (2011). A survey was administered to the sample households using structured face to face interviews and a guiding questionnaire to investigate their views on maize grain moisture content at harvest and to explore maize drying methods they use to dry maize when maize is not dry enough for storage at harvest. The questionnaire was also used to investigate the estimated amounts of maize that farm households harvested annually, the amounts of maize they use for consumption and non-consumption purposes and the proportions of maize they normally lose to pests. Data on the availability of biogas in the research area and the feasibility of using it for maize drying were also collected using the same questionnaire. Farm households were interviewed with respect to the types of toilets they have. This was done in order to investigate the capacity of the toilets used in the study area to accumulate biogas and to determine the possibility of using biogas for maize drying. In addition, 130 maize samples randomly collected at harvest from 130 farm households using the procedure described by Mboya (2011) were tested for grain moisture content to underpin the seriousness of high maize grain moisture content. After five months of maize storage, another set of 130 maize samples were collected from the same households and were tested for insect infestation using the incubation method described by Mboya (2011). The procedure involved randomly collecting 120 maize kernels from each maize sample incubating them in glass jars at room temperatures at 25 - 30 ^{0}C and 75 - 80 % relative humidity to allow growth of insect pests if any. The incubated maize kernels were observed for 90 days and insects that came out of the maize kernels were recorded. A larger proportion of the farm households grew improved varieties of maize, thus 66.9 % of the maize samples of the local varieties and 33.1 % of the improved varieties were studied. Furthermore, 67.7 % of the maize samples were collected from farm households

that used the roof storage facilities to dry maize, and 32.3 % were collected from farm households that dried maize in the sun. A greater proportion of the sample household dried maize in the roof storage facilities as compared to those who dried maize in the sun, hence the variation between the proportions of maize samples collected. Moisture content in the maize grain was established using a moisture content tester.

III. Statistical Analyses

Data was analyzed using the Statistical Programme for Social Sciences (SPSS) version 15 by Pallant (2005). The amounts of maize that farm households lost to infestations and infections were obtained by subtracting the amount that farm households used for consumption and non-consumption purposes from the total estimated amount of maize that farm households harvested per year. T-tests were used to compare the average moisture content in the improved maize varieties and landraces at harvest and to compare the mean insect population density in maize dried in the sun and maize dried in the roof storage facilities. Pearson correlation was used to explore the association between grain moisture content at harvest and insect population density during storage, and also with the proportion of maize lost to pests.

IV. Results

a) Methods that farm households used to dry maize which was not dry enough at harvest and the length of time it took for it to dry

An estimate of 88 % of the farm households would put all of the maize in the roof storage facilities (Figure 1) as a means of drying and storing it at the same time, and about 12 % of them either dried maize exclusively in the sun or used both of the indicated methods. All of the farm households indicated that it took them more than two weeks to dry maize when it is not dry enough at harvest. On average, after five months of storage maize which was dried in the sun had 81 insect pest per 120 maize kernels and sun dried maize had 78 insect pests per 120 maize kernels. Standard deviation was 50.0 and 54.0, respectively. No statistically significant difference between the mean insect population density between maize dried in the sun and maize dried in the roof storage facilities was observed (Table 4). This implies that maize dried using the indicated drying methods was equally infested by insect pests and equally lost to pests.

b) Quantities of maize lost to pests

Farm households harvested an average of 0.88 tonnes of maize annually ranging from 0.1 - 6.33 tonnes per farm households. Farm households that participated in this study normally harvested an estimated total of 235 tonnes annualy, during a good year they harvested an estimate of 277 tonnes and during a bad year they harvested an estimate of 172 tonnes. Standard deviations for the indicated quantities of maize harvests were 6.912, 7.532 and 5.915, respectively. The mean for the total amount of maize that the 260 farm households harvested annually was 228 tonnes, Therefore, since there were 2649 farm households in the studied ward, it was estimated that a total amount of 2323 tonnes of maize were harvested in the ward per annum. Farm households used an estimate of 25 % of the harvested maize annually for consumption purposes, ranging from 0.08 - 0.4 tonnes with 0.2 tonnes mean per household, and used 40.4 % of the harvested maize for non-consumption purposes such as marketing for raising income. In general, farm households used about 65 % of maize for consumption and non-consumption purposes. The amount of maize that each farm household lost to pests ranged from 0 - 0.1 tonnes with ± 0.3 tonnes mean. The total amount of maize that the subsistence farm households lost to infestations per annum was estimated to be 78.8 tonnes. This amounts to an estimate of 800 tonnes of maize, equivalent to 34.4 % of the total harvests. However, an individual farm household could lose up to 80% of the maize harvest.

c) Maize grain moisture content at harvest

Moisture content in the tested maize samples ranged from 13 - 22.6 %, with 16.78% mean and 2.68 standard deviation. A total of 97.7 % maize samples had grain moisture content greater than 13 % (Table 1), and only 2.3 % had 13 % moisture content, indicating that for the majority of farm households maize had high grain moisture content at harvest. T-test results for comparing the average moisture content between the improved varieties of maize and landraces showed no significant difference between the two (Table 2), implying that the failure for maize to be dry enough for storage at harvest characteristized both landraces and improved variaies of maize alike. These findings corroborates with farm households' perspectives regarding maize grain moisture content at harvest. All of them indicated that maize was often not dry enough at the time of harvest.

Furthermore, the maize samples were found to be infested by either weevils only, or moths only, or both weevils and moths. The insect population density in the maize samples ranged from 0 - 52 per 120 maize kernels, the mean was 2.23 and standard deviation was 6.731. Pearson correlation revealed a positive association ($p = 0.316$, significant at $\alpha < 0.01$) between maize grain moisture content at harvest and insect pests population density during storage (Table 3). This implies that insect population during storage increased with increase in moisture content at harvest. This association indicated 10 % of shared variance. A weak, positive association ($p = 0.269$, significant at $\alpha = 0.01$) was also observed between grain moisture content at

harvest and the proportion of maize lost to pests, indicating 7.2 % of shared variance. A strong, positive association ($p = 0.685$, significant at $\alpha < 0.01$) was observed between insect population density during storage, and the proportion of maize lost to pests indicating 46.9 % of shared variance (Table 3). This implies that insect pests played a significant role in maize loss during storage. In addition, an average of 37.5 % of the maize dried in the roof storage facilities was lost to pests as opposed to an average of 35.5 % of the maize dried in the sun also lost to pest.

Standard deviations for the proportions of maize lost to pests were 19.99 and 17.99, respectively. The independent sample T-test revealed the absence of a significant mean difference between the proportions of maize lost to pests for the maize dried using each of the indicated drying methods (Table 4). This means that a high proportion of maize dried using the two drying methods was equally lost to pests during storage.

d) Types of latrines used

An estimate of 95 5 % of farm households were using pit latrines, and only 5 % had modern toilet facilities. However, there is no central sewage system in the whole of Rungwe district. Thus, farm households who had modern toilets built deep pits into which they flashed the toilets. There is no evidence to suggest that a central sewage system has been established in this district. This implies that all of the farm households in Rungwe district have toilet facilities that have capacity to accumulate biogas, and it suggests that the use bio-gas for maize drying could be made possible if farm households were empowered with the technology for harvesting and using it.

V. Discussion

a) The implications of high maize grain moisture content at harvest

The high moisture content in grain at harvest for both landraces and improved varieties of maize could suggest that the season during which maize is harvested is inappropriate, and that more research is required to identify the most suitable maize planting and harvest season in this area. However, the heavy rainfall that characterizes Rungwe district almost throughout the year, coupled with the poor capacity of the maize drying methods in use also suggest that a fast, most effective in- door maize drying technology for combating high grain moisture content at harvest in this place is required.

The fact that it took the farm households more than two weeks to dry maize indicates that the grain moisture content was too high for the maize drying methods used to effectively dry it within the shortest recommended time of up to 48 hours. Consequently, this would encourage the development and multiplication of insect pests in stored maize, and maize loss due to the insect pests (Williams, 2004), which findings in this study support. Moist grain is known to perspire faster than dry grain leading to increase in temperature and moisture content of the grain through condensation (Williams, 2004), which creates favorable conditions for pests especially insect pests, moulds and other micro-organisms. The contaminations associated with the pests would render the farm households vulnerable to illnesses. In this study, moisture content at harvest may have not been a strong determinant of the proportions of maize that farm households lost to pests, but it encouraged the multiplication of insect pests in maize during storage, which further led to maize losses. This further implies that food insecurity and vulnerability of farm households are inevitable due to the reduction in the amounts of maize as a result of insect pests feeding on the maize and due to the contaminations associated with insect pests. Thus an efficient alternative method for drying maize rapidly prior to storage is a basic need for the farm households in this ward.

However, the poor status of farm households suggests that an alternative technology for maize drying should be affordable to the farm households. The use of biogas from pit latrines for drying maize could offer farm households a fast and effective alternative in-door maize dying technology suitable not only for the weather, but also the socio-economic status of the farm households. Therefore, introducing a technology for harvesting biogas from pit latrines and encouraging farmers to build biogas driers using materials that are available to them is necessary for changing the status quo in relation to maize drying prior to storage in Rungwe district.

b) The implications of the quantities of maize lost to pests by farm households

The estimated 800 tonnes of maize lost to pests in Katumba ward per annum is quite huge especially considering the fact that the farm households are only subsistence farmers who produced an annual average of 877 kg of maize each. The estimate of 34.4 % of maize that the farm households lost to the infestations was within the estimated amount of maize that is lost to pests in Tanzania. Up to 34 % of on-farm maize loss due to insect pests has been reported to occur within three months of storage in the country (CIMMYT and Dubin, 2010). Considering that maize is the most preferred food crop in Rungwe district, the percentage of maize lost to insect pests reduces not only the amount of food, but also the length of time during which food can be available to farm households, thus, increasing their vulnerability. Ultimately, this scenario impacts negatively on the farm household's food security. The elimination of all conditions that encourage insect infestation, such as high grain moisture content, could contribute to improving the status quo.

c) Conclusion and Recommendations

This paper has shown that moisture content of maize grain at harvest in Rungwe district is high, that maize drying methods used by household farm households are inadequate in combating the high maize grain moisture content. Consequently, the indicated factors encourage the development and multiplication of insect pests in stored maize, rendering the quality of stored maize poor, and reducing the amounts of maize that could otherwise be available to the farm households. This paper has also shown that the use of biogas for maize drying prior to storage in Rungwe district is feasible. Thus introducing biogas driers made from materials that are available to farm households, and the use of bio-gas from pit latrines for maize drying are highly recommended.

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Table 1 : Maize grain moisture content in at harvest in katumba ward in 2009

Grain Moistwe content	Percent of farm households
13	2.3
13.1 – 13.5	6.9
13.6 – 14.5	10.0
14.6 – 15.5	26.2
15.6 - 17	18.5
17.1 - 20	21.5
>20	14.6

Table 2 : Comparing grain mean moisture content between the improved maize varieties and landraces

		t-test for Equality of Means					
		t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Average moisture content at harvest	Equal variances assumed	1.856	0.066	0.9195	0.4954	-0.0607	1.8997
	Equal variances not assumed	1.844	0.069	0.9195	0.4985	-0.0722	1.9111

Table 3 : Exploring the association between grain moisture content at harvest, insect population density during storage and the proportion of maize lost to pests in Katumba ward

Correlated variables	Pearson correlation	Significant level (2-tailed)
Grain moisture content at harvest and grain insect population density during storage	0.316**	0.000
Insect population density during storage and the proportion of maize lost to pests	0.269**	0.002
Proportion of maize lost to pests and insect population density during storage	0.685**	0.000

** = Correlation is significant at the 0.01 level

Table 4 : A comparison of the mean insect population and the proportion of maize lost to pest between maize dried in the sun and maize dried in the roof storage facilities in Kautmba ward

		t-test for Equality of Means					
		t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95%Confidence Interval of the Difference	
						Lower	Upper
Proportion lost to pests	Equalvariancesassu-med	0.547	0.585	1.9876	3.6329	5.2008	9.1759
	Equal variances not assumed	0.568	0.571	1.9876	3.4993	4.9655	8.9406
Insect population density	Equal variances assumed	0.301	0.764	2.900	9.629	-16.153	21.954
	Equal variances not assumed	0.293	0.770	2.900	9.902	-16.823	22.624

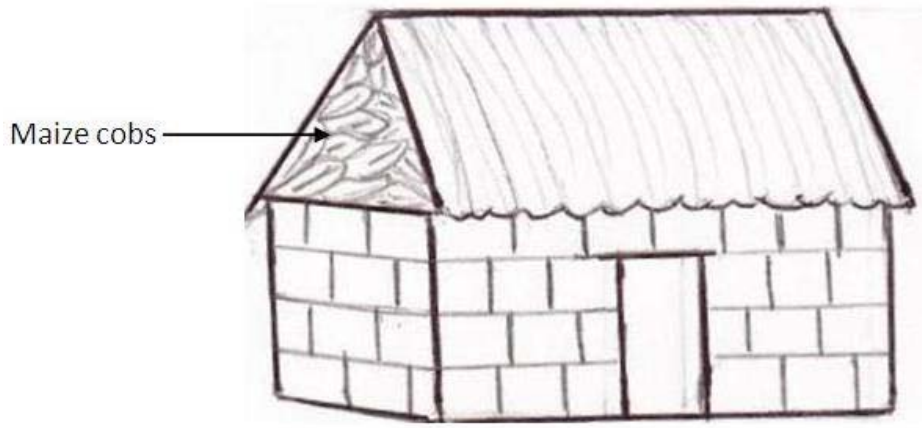

Figure 1 : Roof storage facility also used for maize drying in Rungwe distirct Tanzania

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Comparasion of Different Weed Control Techinques in Maize

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Abstract - Maize is third most important cereal crop in Pakistan after wheat and rice. Experiment was conducted at Agricultural Research Institute Tarnab, Peshawar during Kharif 2007 to study the different weed control technique in maize. The treatments were wheat straw, saw dust, polyethylene (white), polyethylene (black), newspaper, Primextra Gold 720SC, hand weeding and weedy check. The effect of all these treatments were studied on weed density (m-2), fresh weed biomass (g m-2), leaf area (cm2) and cob length (cm). Primextra Gold 720SC and polyethylene (black) giving only (6.5) and (20.0) weeds respectively, as compared to (110.8) weeds m-2 in weedy check plots. Maximum leaf area of 561.23 and Primextra Gold 720SC and polyethylene (black) treated plots respectively. The minimum (464.34 cm2) leaf area was recorded in weedy check plots.

Keywords : *weed density maize, mulching, leaf area.*

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Comparasion of Different Weed Control Techinques in Maize

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Abstract - Maize is third most important cereal crop in Pakistan after wheat and rice. Experiment was conducted at Agricultural Research Institute Tarnab, Peshawar during Kharif 2007 to study the different weed control technique in maize. The treatments were wheat straw, saw dust, polyethylene (white), polyethylene (black), newspaper, Primextra Gold 720SC, hand weeding and weedy check. The effect of all these treatments were studied on weed density (m^{-2}), fresh weed biomass (g m^{-2}), leaf area (cm^2) and cob length (cm). Primextra Gold 720SC and polyethylene (black) giving only (6.5) and (20.0) weeds respectively, as compared to (110.8) weeds m^{-2} in weedy check plots. Maximum leaf area of 561.23 and Primextra Gold 720SC and polyethylene (black) treated plots respectively. The minimum (464.34 cm^2) leaf area was recorded in weedy check plots.

Keywords : weed density maize, mulching, leaf area.

I. Introduction

In the world maize is grown as food and fodder crop. It plays an important role in the over all progress of national economy. It not only the source of food for the increasing population, but also supplies the raw material for domestic industry. It is used for the production of corn oil, corn starch, corn flakes, gluten, germ cake, lactic acids, alcohol and acetone as well as used in the paper industries, textile and fermentation etc. In spite of its high yield potentialities, average maize yield in Pakistan is still very low a compared to other maize producing countries of the world. Improvement in average yield per hectare can be made if superior genotypes combined with appropriate production technology i.e. herbicide application are developed and adopted by growers.

Nyakatawa (1997) studied the effect of sorghum stover and tree leaf mulches on seed yields and yield components of maize (*Zea mays* L.), sorghum (*Sorghum bicolor* L.), and sunflower (*Helianthus annus* L.) crops in tied ridges under rainfed conditions at Chiredzi Research Station in 1993/94 and 1994/95 seasons. Mulching significantly increased maize seed and stover yields by 26% in 1993/94 and showed some improvement in total soil water content and water use efficiency over the control treatment in 1994/95 season. Seed yield of sunflower was significantly correlated (r = 0.55) to cumulative soil water content in 1994/95. Stover yield for sunflower was significantly correlated (r = 0.60) to cumulative soil water content in 1994/95. The results from this study suggest that sorghum stover and dry tree leaf mulches had significant beneficial effects on maize performance in a year with good and well distributed rainfall whereas for sorghum and sunflower, the benefits were higher in the drier year. Miura and Watanabe (2002) evaluated the effect of living mulch, we examined the weed biomass and the growth and yield of sweet corn (*Zea mays* L.) cultivated with three legume living mulches without the application of herbicide and without tillage. The living mulch plants alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.) and white clover (*Trifolium repens* L.) were seeded in autumn. During the corn growth period in the following year, weed growth was effectively suppressed by all three living mulch plants. Both growth rate and yield of sweet corn with white clover living mulch were comparable to the conventional cultivation, but alfalfa and red clover living mulches caused the yield reduction in sweet corn. The percentage of stand was thought to have been reduced due to the competition for light and nutrients. The nitrogen absorption rate of sweet corn increased with its growth. On the other hand, the nitrogen absorption rate of living mulch plants decreased with the growth of sweet corn. These results suggest that competition between sweet corn 558.56 cm^2 was produced by and living mulch plants for nitrogen would be small. We concluded that white clover is the best of the three legume living mulch plants for weed control without significantly affecting sweet corn production. Sanchez *et al.* (2008) evaluated mulches usable in organic production in high tunnels for their ability to suppress weeds.

II. Materials and Methods

A field trial was carried out at Agricultural Research Institute Tarnab, Peshawar. The treatments were wheat straw, saw dust, polyethylene (white), polyethylene (black), newspaper, Primextra Gold 720SC, hand weeding and weedy check. The treatment were assigned to Randomized Complete Block (RCB) design and replicated four times.

The effect of all these treatments was studied on

1. Weed density (m^{-2})
2. Fresh weed biomass (g m^{-2})
3. Leaf area (cm^2)
4. Cob length (cm)

The data recording on the aforesaid parameter were subjected to ANOVA Technique by using MSTATC Computer soft ware and means were separated by

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using Fisher protected LSD test. (Steel and Torrie, 1980).

III. Results and Discussion

a) Weed Density m^{-2}

Statistical analysis of the data revealed that number of weeds m^{-2} were significantly ($P \leq 0.05$) affected by various mulches in maize crop (Table-1). Mean values of the data shown in Table-2 indicated that maximum weeds (110.8 m^{-2}) were recorded in weedy check plots, while among the herbicidal and mulch treatments minimum weeds (6.5 and 20.0 m^{-2}) were recorded in Primextra Gold 720SC and polyethylene (black) treated plots, respectively. Weed density was significantly affected by different treatments. So Primextra Gold 720SC indicated best control of grasses as well as broad leaf weeds. Our results are in agreement with the work of Schonbeck (1998). They reported that weed control methods significantly affected weed density m^{-2}.

b) Fresh weed biomass (g m^{-2})

Analysis of the data presented in Table-1 showed that fresh weed biomass was significantly ($P \leq 0.05$) affected by various mulches in maize crop. Mean values of the data presented in Table-2 indicated that maximum fresh weight of 210.69 and 116.47g were recorded in weedy check and wheat straw plots. While minimum (6.25 and 43.43g) were recorded in Primextra Gold 720SC and polyethylene (black). Our results are in line with those reported by Ngouajio and Ernest (2004).

Table 1 : Mean squares for weed density m^{-2} and fresh weed biomass (g m^{-2}) as affected by different mulches in maize

Source	D.F.	Weed density m^{-2}	Fresh weed biomass (gm^{-2})
Replications	3	104.375	179.828
Treatments	7	4250.768**	15548.729**
Error	21	49.875	117.743
C.V (%)		18.55	14.12

D.F. =Degree of Freedom
** = significant at 5% level of probability.

Table 2 : Weed density m^{-2} and fresh weed biomass (g m^{-2}) as affected by different mulches in maize

Treatments	Weed density m^{-2}	Fresh weed biomass (gm^{-2})
Wheat straw	56.0 b	116.47 b *
Saw dust	35.5 c	76.24 c
Polyethylene (white)	24.5 d	52.39 de
Polyethylene (black)	20.0 d	43.43 e
Newspaper	28.0 cd	59.67 d
Primextra Gold 720SC	6.5 e	6.25 f
Hand weeding	23.3 e	49.79 de
Weedy check	110.8 a	210.69 a
LSD value at 5%	10.39	15.96

* Means followed by different letters in the respective column are significantly different by LSD test at 5% probability level.

c) Leaf area plant^{-1} (cm^2)

Statistical analysis of the data revealed that leaf area was significantly ($P \leq 0.05$) affected by different treatments (Table-3). Mean values of the data shown in Table 4 revealed that maximum leaf area of 561.23 and 558.56 cm^2 was produced by Primextra Gold 720SC and polyethylene (black) treated plots respectively. The minimum (464.34 cm^2) leaf area was recorded in weedy check plots. As leaf is the basic photosynthetic machinery for plant food, hence its size would directly affect the yield and yield components of crop. These results were in great agreement with the work of Liedgens *et al.* (2004). They observed that cultural weed control gave greatest leaf area at teaseling.

d) Cob length (cm)

Analysis of the data showed that different mulch treatments had a non- significant ($P \leq 0.05$) effect on cob length (Table-3). The data presented in Table-4 indicated that maximum cob length of 17.79 cm was recorded in Primextra Gold 720SC plots, while minimum cob length of 16.44 cm was observed in weedy check plots. However the cob length in the best treatment is statistical similar with the rest of the treatments.

Table 3 : Mean squares for leaf area plant^{-1} (cm^2) and cob length (cm) as affected by different mulches in maize

Source	D.F.	Leaf area (cm^2)	Cob length (cm)
Replications	3	390.123	0.754
Treatments	7	4880.522**	1.068
Error	21	483.458	1.229
C.V (%)		4.17	6.47

** = significant at 5% level of probability.
D.F. =Degree of Freedom

Table 4 : Leaf area plant^{-1} (cm^2) and cob length (cm) as affected by different mulches in maize

Treatments	Leaf area (cm^2)	Cob length (cm)
Wheat straw	487.60 c *	16.59
Saw dust	525.03 b	16.79
Polyethylene (white)	534.10 ab	17.28
Polyethylene (black)	558.56 a	17.71

Newspaper	530.23 ab	16.97
Primextra Gold 720SC	561.23 a	17.79
Hand weeding	555.81 ab	17.55
Weedy check	464.34 c	16.44
LSD value at 5%	32.33	NS

* Means followed by different letters in the respective column are significantly different by LSD test at 5% probability level.
NS = Non-significant.

e) Conclusion and Recommendation

From our data it was concluded that Primextra Gold 720SC proved the best for controlling weeds in maize crop. Further research is needed in future for weed control in maize.

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Depleting Water Resources of Indian Punjab Agriculture and Policy Options-A Lesson for High Potential Areas

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Abstract - During the past half century, the Punjab State achieved exemplary growth in food-grain production. The fast shift in area from traditional diversified crops to monoculture of rice-wheat system was driven by forces such as price policy, technological change, market infrastructure and low cost of irrigation. But due to over exploitation of water resource, the sustainability of existing crop systems is becoming doubtful, creating critical second generation problem. This requires separate treatments in three distinct agro-climatic regions of the state. The semi-hilly tracts, comprising about 10% area, requires check dams against fast water run-off, cultivation across the slope and crops using less water such as maize, groundnut, pulses etc. The potential cotton belt, forming one-fourth area, has brackish groundwater which needs to be used in conjunction with canal water; and the paddy crop in the area should be strictly discouraged. The fast receding water table in the central food security belt of the country is attributed to spreading rice cultivation. This demands policies of suitable water pricing; setting up tension-meters to monitor water requirements; laser leveling fields; keeping plot size smaller; genetic improvement of rice by developing short duration and late sown varieties; direct seeding of rice; encouraging sprinkler and drip irrigation; mulching with abundant quantities of crop residues and various other such agronomic practices.

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Depleting Water Resources of Indian Punjab Agriculture and Policy Options-A Lesson for High Potential Areas

Dr. Joginder Singh

Abstract - During the past half century, the Punjab State achieved exemplary growth in food-grain production. The fast shift in area from traditional diversified crops to monoculture of rice-wheat system was driven by forces such as price policy, technological change, market infrastructure and low cost of irrigation. But due to over exploitation of water resource, the sustainability of existing crop systems is becoming doubtful, creating critical second generation problem. This requires separate treatments in three distinct agro-climatic regions of the state. The semi-hilly tracts, comprising about 10% area, requires check dams against fast water run-off, cultivation across the slope and crops using less water such as maize, groundnut, pulses etc. The potential cotton belt, forming one-fourth area, has brackish groundwater which needs to be used in conjunction with canal water; and the paddy crop in the area should be strictly discouraged. The fast receding water table in the central food security belt of the country is attributed to spreading rice cultivation. This demands policies of suitable water pricing; setting up tension-meters to monitor water requirements; laser leveling fields; keeping plot size smaller; genetic improvement of rice by developing short duration and late sown varieties; direct seeding of rice; encouraging sprinkler and drip irrigation; mulching with abundant quantities of crop residues and various other such agronomic practices. Therefore, collaborative efforts of researchers, policy makers, farmers and extension services can help in tackling the situation.

Keywords : water resources, policy options, environment.

I. Introduction

Water is the most essential ingredient of human, animal and plant life but as a public good, the use of it not being made judiciously. Both inadequate and excessive use of this resource may restrict the crop yields due to severe abiotic stresses. Due to increase in population of the country, the per capita surface water availability was 5410 m^3 in 1951 but has slid down to 1902 m^3. The availability projected for 2050 is 1451 m^3 and 1235 m^3 with low growth and high growth respectively (Kumar et al, 2005). The availability of water has also high spatial variability. Thus alarming rate of depletion of such precious resource calls for appropriate measures in terms of creating general awareness of users, processes, innovations and policies to enhance its use efficiency are required to normalize the inter-regional and overtime water use for different purposes.

Punjab is a small state of India occupying only 1.5% of the geographical area of the country. The state, popularly known as the "Granary of India" is contributing 21% of wheat, 11% rice and 10% cotton of the country's total output apart from sizable share in the production of various other crops. Thus, by exploiting high potential agriculture of the state, the country which was in the grip of serious food shortage till sixties has now been able to generate even surpluses apart from meeting the needs of its rapidly growing population. The technology encompassing intensive cultivation making high use of agro-chemicals, water and mechanical power has resulted in manifestation of several adverse effects on ecological balance such as fall in water table, developing pest resistance, degrading soil fertility, eroding bio-diversity etc. The underground water is being used indiscriminately. This paper, therefore, is an attempt to examine the water related issues emerging from inter-temporal developments in Punjab agriculture. Specific objectives of the study are;

1. To study the quantum of water use due to increase in cropping intensity and cropping pattern
2. To analyze the rationale and consequences of overuse of water.
3. To suggest measures to minimize the ill-effects of over-exploitation of this natural resource.

II. Data Sources

The study makes use of primary and secondary sources of data. The secondary data available on land use, cropping pattern, average yield of different crops in the state, area irrigated by different sources etc were collected to provide background of emerging problem concerning water resource. A few studies on this aspect already carried out were also reviewed. The analysis based on data collected from various sources such as Hydrology section of State Department of Agriculture, primary farm level data, secondary data on crop pattern and productivity and rainfall data of the state was done which has been used here too (Singh, 2004). It was supported by some other empirical evidences having association with the problem. The water requirements of

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different crops and other technical parameters were estimated with the help of soil and water engineers of Punjab Agricultural University.

III. Land Use and Production Pattern

Out of the total geographical area of 5 million hectares of the state, about 4.2 million hectare is the net area sown. The unculturable land has been reclaimed and fallow land has been brought under cultivation. The cropping intensity also went up from 126% to 190% during this period. The coverage of land by more crop area has created still higher demand for use of water resource. The area under forests has also increased though at a slow pace yet it is much less than the requirement for maintaining ecological balance.

As may be seen from table 1, rice occupied merely 4.80% of the total cropped area in 1960-61 but registered a steep rise up to 35.41% in 2008-09. It did not confine only to traditional paddy belt but spread over to all the districts wherever adequate irrigation facilities were made available. Similarly, the area under wheat increased from only 27.32% in 1960-61 to 44.51% of total cropped area in 2008-09 but the stage has now reached beyond which increase appears to rather impossible. On the other hand, area under maize, millets, sorghum, groundnut, gram, barley and lentil has fallen rapidly. However, cotton, sugarcane, pulses, rapeseed and mustard, potato and other vegetables have shown wide fluctuations from year to year.

Thus the production pattern in the Punjab State has become predominantly a monoculture of rice-wheat rotation because of higher profitability of these crops resulting from faster increase and higher stability in the productivity and effective price support by the government in comparison to other competing crops. The economic considerations in the choice of crops with higher requirement of water have thus overruled the exploitation of the natural resource endowments, particularly water. The index of water use on the basis of average number of irrigations applied to various crops by the farmers was worked out. Due to increase in area under cultivation, cropping intensity and shift in crop pattern, the water requirement during the past five decades has gone up by about 170 per cent. On the other hand, there is ample evidence to indicate that the Total Factor Productivity of these crops has gone down, mainly due to ecological problems pertaining to depletion of soil fertility, water availability and pest resistance (Singh & Hossain, 2002).

IV. Intensity of Water Scarcity Problem

a) A Review

Prihar et al. (1993) estimated that good quality water was available to the extent of 3.12 million hectare meters or 25.34 million acre feet (MAF), whereas the normative requirement amounted to 39.75 MAF. The net deficit, therefore, comes out to 14.41 MAF. They warned that unless a very serious view was taken of the matter and immediate corrective policy measures adopted, the state would head towards a critical water famine situation. Singla, (1992) observed that water table in the sweet water region of the state during 1979-1991 was receding annually on an average by 0.2 meters. A situation might arise when the water table would go down to such an extent that lifting water would require heavy capital investment in the form of high power electric motors or submersible pumps and also increased energy consumption and ultimately, it may even become technically and economically an unfeasible proposition.

Batta Nidhi (2007) discussed the problems related to water use in Punjab emerging from faulty water and crop management practices, rapid urbanization and industrialization. The water resources should be used rationally so that it can is saved for our next generations by following various techniques such as canal water management, improving on-farm water use efficiency, conjunctive use of water, artificial recharge of ground water etc.

According to National Academy of Agricultural Sciences (2011) water-table in 82 per cent area of Punjab and 63 per cent of that in Haryana has gone down substantially. The study revealed that in Punjab groundwater at a depth of above 10 metre was only on 4 per cent of the area in 1973 and on 75 per cent area in 2002. The net annual groundwater draft in Punjab exceeds availability by 45 per cent. The study suggested that more water-saving options need to be introduced and promoted for managing groundwater judiciously and efficiently in Punjab described as "granary of the country."

Based on the water table data collected regularly, it was brought out that in 9,058 sq km of central Punjab it has gone down by more than 20 metres in the past one decade and the trend is continuing with some districts registering a fall despite a good monsoon of 2010 (Sidhu, 2011). Further, for both the pre- and post-monsoon periods collected by the Agriculture Department painted a grim picture. The water table has gone down all over the state in the one-year period from June 2009 to June 2010. What is even more alarming is that areas in central Punjab have witnessed a dip in the water table even post- monsoon last year. This is the time when the water table invariably goes up. Experts claim that the state needs 52 MAF of water to sustain its present intensive cultivation. It has only 14.54 MAF of canal water leading to over exploitation of ground water. With farmers reluctant to reduce area under paddy cultivation, this over exploitation is likely to continue. The area under hybrid maize, which is being looked as an alternative to paddy, is stagnating at 1.50 lakh hectares.

b) Water Resource in different Agro-climatic Regions The spectacular increase in agricultural production in Punjab has been made possible due to expansion of irrigation network covering 97% area in 2008-09 as compared to only 54% in 1960-61 (Table 3). The area covered by canals in absolute is almost same. But in terms of percentage area irrigated, it is declining. The canals used to irrigate 58.4% of the total irrigated area in 1960-61, the share of which has declined to about 27.5% due to almost constant availability of water in the reservoir, continued seepage of water from canals and above all the shift in area towards higher water using enterprises. On the other hand, the underground water was being exhausted through tubewells at a faster rate which covered 73% of the total irrigated area in 2008-09 as against only 41% in 1960-61. The fact of over-exploitation of water is further authenticated by the increase in the number of tubewells from 192 thousand in 1970-71 to 1276 thousand in 2008-09.

The analysis across the agro-climatic regions showed that the coverage of canals declined in all the regions, while the tubewells registered faster coverage, more so in the South-Western (cotton) belt over the last two decades. During the last decade the average fall of water table in the central Punjab was 0.55m/year. At some places the ground water level declined at the rate of even 0.75 to 1 m/year. On the other hand, the water table is rising in south- western districts. Kandi area has its own problems of shortage of irrigation water in spite of heavy rainfall (Hira et. al 2004).

The problems relating to macro-level water management require separate focus in the three different agro-climatic regions of Punjab.

i. *The sub-mountainous (Kandi) region*

Has undulating topography. The annual rainfall is more than 1000 mm. Due to denudation of upper hills resulting from over-grazing and deforestation, there is high run-off of water resulting from flash floods and heavy soil erosion. During the last 2 decades, the number of tubewells almost doubled, providing irrigation to 84% of the total irrigated area while the surface water have not been well channelized (Table 4). Since water table is deep and soil is rocky, pumping out water is relatively uneconomical. Therefore, although there is problem of increasing use of water in this area but decline in water table is not severely aggravated.

ii. *The central (sweet water) region*

Comprising the major part of the state is highly productive and has well knit system of irrigation, mainly in terms of tube-wells. The paddy-wheat is the major crop rotation followed in this belt. The water table in this zone has been falling with an average rate of 0.23 meter per year for the last 15 years (Gupta et. al., 1995). This belt had 5-6 meters of water table in 1981 and showed a fall of 24-25 cm per annum. This is a matter of serious concern and the trend needs to be arrested since it would need additional power requirement. If the decline in water table is continued at the existing rate, most of the centrifugal pumps would have to be replaced by submersible pumps, which would amount to tremendous cost on the farm sector. The state government's design to make electricity for irrigation completely free of cost since 1997 further contributed to the problem of declining water table resulting in indiscriminate use of water. Therefore, the prevalent production pattern seems to be unsustainable in the long run.

iii. *The south-western region*

Comprising almost one-forth of the cultivated area of the state, popularly known as cotton belt has deep and brackish underground water. The area under irrigation has increased tremendously in this belt recently. The network of canal water supply in the area improved but could not cater to the requirements of increasing cultivated area, cropping intensity and area under water intensive crops. Thus the use of underground poor quality water through tubewells has been increasingly overexploited. With about 11-12 meter water depth in 1981, it is continuously showing a rise of 20-22 cm per year motivating the farmers to shift from cotton to rice cultivation. This has been largely responsible for the fast declining productivity of cotton due to the fact that:

a) The use of underground water has increased accumulation of salts on the soil surface deteriorating its health.
b) The higher inflow of canal water in some area has caused rise in water table and even water-logging in some pockets of this zone.
c) The high humidity resulting from paddy cultivation and water-logging of soil has encouraged the built-up of insect-pests, threatening the cultivation of cotton in this belt.

Therefore, in brief, water harvesting in semi-hilly areas, recharging the underground water in the central belt, encouraging water saving practices and shift in crop pattern in the south-western areas of the state can ease the situation significantly. The rainfall helped to improve the situation significantly but drawl due to paddy area alone equalized the recharge. The net deterioration of water balance situation was owing to parameters other than this including increase in cropping intensity, higher water use by other crops, non-agricultural uses (Singh, 2004)

c) Energy Requirements

Due to fall in water table, particularly in the central belt;

a) The cost of pumping out water has increased. The power required for lifting water from deeper surface is much higher than the shallow one.

b) The centrifugal pumps are being replaced by submersible pumps.
More number of electric tubewells is being installed.
c) The electricity is thus getting in short supply, as a result of which the diesel pumps are being increasingly used to supplement the electric tubewells.

The impact were substantiated (Singh 2004) with the help of overtime primary data collected from a sample of farmers and inferred that with the passage of time, the water crisis is aggravating by additional energy requirement and cost of exploring deeper water aquifers.

d) Farmers' Practices and Water Requirement

It is not only increase in rice area and government policies that the water use has gone up, but the farmers, by way of their faulty practices are also responsible for aggravating the problem of water scarcity as discussed under:

i. *Early Transplanting of Rice*

Against the recommended time of transplanting of second week of June, about 25% rice area in the state is transplanted in the month of May. The reasons advocated by the farmers were that the early rice crop escapes pests and diseases and gets longer growing period resulting in higher yield. Similarly, the low opportunity cost of family and permanently engaged labour and farm machinery lowers the cost of cultivation if the crop is transplanted early. The estimated evapo-transpiration of rice crop has been averaged to 780 mm in the month of May as compared to 605 mm in case of timely transplanted (Hira & Khaira, 2000). Thus the early transplanted rice crop has about 29% higher water requirements and over-exhausts the annual water resources in the state by 7.3% every year. The policy of late procurement of paddy by the state agencies has recently helped to restrict the early transplanting to some extent.

ii. *Long Duration Varieties*

The varietal picture of rice crop in Punjab indicates that some varieties which are of long duration and are not recommended by the experts but still the farmers have adopted on a large area. For example, PUSA 44 variety has been cultivated on 30% area and thus the water requirement of the crop increased tremendously. Conversely, basmati, a superior strain of rice having lesser water requirement has almost doubled from about 5% to about 10% of total area under rice crop during the last 4-5 years. However, the global demand for basmati has pushed up basmati production recently, helping in water saving.

iii. *Ignorance about ill-effects of water use in paddy*

The water use by the farmers is in excess of the requirement of the paddy crop. Higher intensity and more number of irrigations were, largely due to ignorance of the majority of farmers that good crop requires standing water throughout (Chatha et al. 1994) and also due to low price of water.

iv. *Lack of suitable water management practices*

There are a number of agronomic practices through which enormous saving of water can be made possible. For example in place of open flooding system, ground pipe line furrow irrigation/ raised beds, drip and sprinkler irrigation, in-situ retention of rain water, mulching could improve the water use efficiency. Apart from timely transplanting with suitable varieties avoiding early and long duration varieties, conjunctive use of water, renovation of village ponds for irrigation, encouraging crop diversification (substituting high water requiring crops/ cultivars) are some other ways to solve the problem through various policy measures.

Therefore, to curb the over exploitation of water, policy legislation and extension, education of farmers in this respect are required for which in place of providing free electricity for the tubewells, subsidies on water saving technologies should be provided.

e) Water pricing and productivity

The average productivity of water was estimated on the basis of state average yield of crops and post-harvest prices. The value of by-product was also taken into account in the estimation process. The total quantity of water used was worked out on the basis of number of irrigations applied and 7.5 cm as an effective irrigation. It is evident from Table 5 that per cubic meter of water, the gross return varied from crop to crop viz. Rs2.43 in case of paddy, Rs6.75 for rapeseed & mustard crop, Wheat crop yielded Rs12.36, while the cotton crop promised Rs11.40/cu.m of water. Viewing it from another angle, to produce one kg of paddy grain required 4334 liters and wheat as 1080 liters. The cotton crop needed as much as 2394 liters of water for one kg output of seed cotton. Therefore, production and even export-import policy of agriculture sector, apart from economic parameters should take a serious view of requirements of natural resources especially water.

V. Policy Prescriptions

- Diversification of agriculture through alternative crop systems such as cotton, basmati, maize, oilseeds and pulses, fruits and vegetables, dairy etc need to be encouraged in different agro-climatic conditions with the help of effective support price, processing and export infrastructure.
- Agronomic practices such as timely transplanting of rice, furrow irrigation, avoiding excessive flooding of fields, smaller fields, sprinkler and drip irrigation wherever possible could reduce the water requirements sizably.
- Suitable water pricing especially through metered system of electricity supply is essential.

- It has been estimated that about 60 per cent of irrigation water is lost in the form of seepage losses. Therefore, lining of canals, water courses and field channels, use of underground pipeline for conveyance of irrigation water should be practiced.
- A package of measures to increase the artificial recharge to augment the groundwater reservoir has to be taken. It has been estimated that the total unutilized water works out to be 0.433 million hectare meters, out of which 0.372 million hectare meters is through rivers and the rest comes through drains, *nullahs*, etc. This water is a potential source which can be utilized for artificial recharge to groundwater.
- The conjunctive use of surface and groundwater will help in developing strategy of irrigation for optimal agricultural development. The studies have revealed that an integrated approach for conjunctive use of surface water and poor quality groundwater supplemented with application of gypsum amendment and proper facilities for drainage on sodic soils could also reduce pressure on fresh water use.
- Export-import policy must take into account the use of water resource apart from comparative economic advantage of different crops.

VI. Summary

A dramatic change with storming of rice in crop pattern was witnessed in high potential Punjab agriculture. This was a consequence of technological transformation and support price policy of government from food security angle. It led to fast overexploitation of water resources of the state and the water requirements of farm sector have gone up by about 170% during the past one and a half century. However, groundwater recharging through network of canals was not matching. The ruthless pumping out of groundwater in the central food grain belt and drifting away of surface water in the distantly located cotton belt which has brackish groundwater was at a heavy social cost through frequently deepening of tubewells and higher energy input for drawing water. It is essential to rationalize the farmers' practices through education and policy measures. It also lacks rationality to produce for the market without visualizing the future scenario. For instance, to produce one kg of paddy, more than four thousand liters of water is applied. In other words, to produce paddy worth Rs2.43, a cubic meter of water is applied. With liberalization of trade, more profitable crops in terms of water use efficiency have to be viewed and policies need to be reframed accordingly.

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Table 1 : Shift in Cropping Pattern of Punjab and Water Requirements

(Area in 000 ha)

Crop	1960-61	%	1980-81	%	2000-01	%	2008-09	%
Rice	227	4.8	1183	17.49	2612	32.92	2802	35.41
Maize	327	6.91	382	5.65	164	2.07	139	1.76

Bajra & Jowar	140	2.96	70	1.04	6	0.08	3	0.04
Groundnut	67	1.42	83	1.23	4	0.05	3	0.04
Cotton	446	9.43	648	9.58	474	5.97	511	6.46
Sugarcane	133	2.81	71	1.05	121	1.52	60	0.76
Kharif Pulses	32	0.68	61	0.9	42	0.53	16	0.20
Sesamum	8	0.17	17	0.25	19	0.24	7	0.09
Wheat	1400	29.59	2812	41.58	3408	42.95	3522	44.51
Barley	66	1.39	65	0.96	32	0.40	14	0.18
Gram	838	17.71	258	3.81	8	0.10	3	0.04
Rapeseed & mustard	106	2.24	146	2.16	55	0.69	30	0.38
Lentil	30	0.7	20	0.33	5	0.06	0	0.00
Potato	9	0.19	40	0.59	70	0.88	83	1.05
Other vegetables	23	0.49	24	0.35	46	0.58	34	0.43
Fruits	42	0.89	29	0.43	34	0.43	68	0.86
Fodder & others	859	18.15	959	14.18	657	8.28	617	7.80
Total cultivated area	3757		4191		4264		4171	52.72
Total crop area	4732	100	6763	100	7935	100	7912	100
Water requirement index		**100.00**		**173.4**		**259.1**		**270.1**

% means the area under the crop as per cent of Total cropped area

Area under vegetables, fodder and other crops is not shown crop-wise due to paucity of split up of such data Fruits are perennial and the figures pertaining to area under fruits are also not much reliable.

Water requirement index was worked out on the basis of number of irrigations applied by farmers to different crops.

Table 2 : CGR of Average Yield of major crops in Punjab (%)

Crop	Period I 1970-71 to 1980-81	Period II 1980-81 to 1990-91	Period III 1990-91 to 2000-01	Period IV 2001-02 to 2009-10
Rice	4.67	1.17	0.43	1.77
Wheat	2.27	2.92	1.99	0.19
Sugarcane	3.09	0.37	0.26	-0.08
Cotton	-1.82	7.24	-5.83	7.95

Table 3 : Area (000ha) irrigated by different sources in Punjab

Year	Canal	Well and Tubewell	Other sources	Total irrigated	Net area irrigated (%)
1960-61	1180 (58.4)	829 (41.0)	11 (0.2)	2020 (100.0)	54
1970-71	1292 (44.7)	1591 (55.1)	5 (0.2)	2888 (100.0)	71
1980-81	1430 (42.3)	1939 (57.3)	13 (0.4)	3382 (100.0)	81
1990-91	1669 (42.7)	2233 (57.1)	7 (0.2)	3909 (100.0)	93

2000-01	962 (23.8)	3074 (76.1)	2 (0.1)	4038 (100.0)	95
2008-09	1113 (27.4)	2950 (72.6)	1	4064 (100.0)	97

Figures in parentheses indicate percentages
Source: Statistical Abstract of Punjab 2001

Table 4 : Area (000 ha) irrigated in different zones of Punjab

Zone	Canal			Tubewell and Well		
	1975-76	2000-01	2008-09	1975-76	2000-01	2008-09
Sub-mountainous belt	87 (26.7)	45 (7.6)	81 (16.5)	238 (73.3)	553 (92.4)	409 (83.5)
Central plains belt	430 (25.7)	312 (16.3)	149 (9.9)	1246 (74.3)	1601 (83.7)	1350 (90.1)
South-West cotton belt	816 (71.3)	645 (42.8)	883 (44.2)	329 (28.7)	863 (57.2)	1113 (55.8)
State	1332 (42.4)	1002 (24.9)	1113 (27.4)	1813 (57.6)	3017 (75.0)	2950 (72.6)

Figures in parentheses indicate percentages
Source: Statistical Abstracts of Punjab

Table 5 : Return/ cubic m use of water for different crops in Punjab, 2008-09

Crop	Av. Yield	Price	Gross return**	No of irrigations	Water	Gross return	Water use**
	(Kg/ha)	(Rs/q)	(Rs/ha)		(cu.m./ha)	(Rs/cu meter)	Lit/kg of output
Paddy	6015	980	58947	22	24264	2.43	4034
Maize	3964	900	35676	5	5512	6.47	1391
Millets	1495	910	13605	2	2269	6.00	1518
Groundnut	1240	2850	35340	2	1985	17.80	1601
Cotton*	2303	2730	62872	5	5514	11.40	2394
Sugarcane*	6672	2200	146784	15	16539	8.88	2479
Kharif Pulses	840	5000	42000	2	2198	19.11	2617
Sesamum	356	6000	21360	2	2219	9.63	6233
Wheat	5107	1335	68178	5	5515	12.36	1080
Barley	3537	875	30949	4	4400	7.03	1244
Gram	1129	5000	56450	2	2233	25.28	1978
Rapeseed & Mustard	984	3022	29736	4	4405	6.75	4477
Rabi pulses	1284	5000	64200	2	2200	29.18	1713
Potato	25464	800	203712	5	5508	36.98	216

*Cotton yield in terms of seed cotton and Sugarcane in terms of gur with 10% recovery

** The quantity of water use is based on average number and intensity of irrigations applied by farmers and thus does not account for its percolation in the soil.
1US$ = Indian Rs45 approximately

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Performance Assessment of Some Developed Surface Irrigation Methods

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Abstract - Irrigation development is a gateway to increased agricultural, water and land productivity, increased household and national food security. However, irrigation development has been a major challenge in many developing countries, including Egypt. The overall objective of this study is to detect the influence of different irrigation systems on water-use efficiency, crop and soil salinity in highly soil salinity. Two techniques were applied in experiment, the first technique was siphon irrigation, and the second one was pipeline with gates. The monitored parameters were water table depth, water and soil salinity and crop yield. The total leaching water requirements was given to control the salinity and the crop production. The study revealed that the cotton crop yield was higher by 17% with gate pipeline treatment compared to siphon irrigation treatment. The total soil salinity increased in both treatments. The siphon method gives highest value of total salinity at all seasons. This method increased the salinity by 2.7% while the pipeline with gate increased the salinity by 12.9%. Convergence the value of the crop coefficient in all relations used in most stages of growth, except Penman relationship which gave the highest values.

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Performance Assessment of Some Developed Surface Irrigation Methods

N. B Abdelmageed

Abstract - Irrigation development is a gateway to increased agricultural, water and land productivity, increased household and national food security. However, irrigation development has been a major challenge in many developing countries, including Egypt. The overall objective of this study is to detect the influence of different irrigation systems on water-use efficiency, crop and soil salinity in highly soil salinity. Two techniques were applied in experiment, the first technique was siphon irrigation, and the second one was pipeline with gates. The monitored parameters were water table depth, water and soil salinity and crop yield. The total leaching water requirements was given to control the salinity and the crop production. The study revealed that the cotton crop yield was higher by 17% with gate pipeline treatment compared to siphon irrigation treatment. The total soil salinity increased in both treatments. The siphon method gives highest value of total salinity at all seasons. This method increased the salinity by 2.7% while the pipeline with gate increased the salinity by 12.9%. Convergence the value of the crop coefficient in all relations used in most stages of growth, except Penman relationship which gave the highest values.

Keywords : siphon irrigation method, pipeline with gate irrigation method, subsurface drainage, water-table management, water-table salinity, soil salinity, and crop yield.

I. Introduction

As water is becoming more and more a scarce resource all over the world, proper management of the available water is essential. For an optimal use of the available water resources, water management strategies have to be developed. Soil salinity problems generally occur in arid and semiarid regions and reduce crop production at different levels. Salinity is also a major limiting factor for crop yield in poorly drained soils [1, 2, 3, and 4]. [5] recommend that national governments should formulate and hold sound irrigation development strategies and encouraged to partner with public and private institutions in defining and implementing such comprehensive strategies for sustainable irrigation development. [6] notes agriculture has dominated the Zimbabwean economy despite contributing only 15-20% to Gross National Product. It provides income to over 75% of the population of 12 million. In most years, 95% of all food beverages have been locally produced and agriculture accounted for 30% of formal sector employment and over 40% of total national exports. Manufacturing is dependent on agriculture as a source of raw materials with most consumer expenditure on products derived from agriculture. Moreover, about 80% of the rural population lives in Natural Regions III, IV and V where rainfall is erratic and unreliable, making dry-land cultivation a risky venture. Climatic conditions are largely sub-tropical with one rainy season, between November and March. Rainfall reliability decreases from north to south and also from East to West. Only 37% of the country receives rainfall considered adequate for agriculture. This makes irrigation development a prerequisite in these areas. [7] recommend a proper field preparation, including for instance a laser-guided land leveling is necessary before bed making to facilitate a uniform distribution of irrigation water; a suitable bed height, i.e., 10-15 cm height, is needed for efficient salt leaching; adequate soil moisture content needs to be ensured during planting to obtain a proper plant stand; the use of appropriate herbicides for weed control is advantageous; the use of appropriate machinery to drill seed and fertilizer at the proper depth is compulsory; a reshaping of beds during planting, if necessary; the use of short-maturing crop varieties is advantageous. [8] Abdel Ghaffer, and Wahba studied the sub-irrigation method to manage the water table and the effect of method on wheat crop.

II. Methodology

a) Experimental Site

The experiments were carried out in a farm in western Delta, Egypt. The experimental area is divided into lines where each line 200m in length and 0.75m in width and has a sandy silt loam to clay loam texture, The field hydraulic conductivity was measured using the auger hole method and the average value is 2.0 m/day. The main source of the irrigation water is supplied from field canal. The site is served by a subsurface drainage system. The collector drains (PVC corrugated plastic pipe) have been installed at about 1.5 m depth and all laterals drains (PVC corrugated plastic pipe covered by synthetic envelope materials) have been installed at a depth of 1.2 m with an average space of 80 m. The lateral drains were sloped at 10% and exit directly to the main collector through a manhole. Figure 1 shows the experimental study.

Observation wells network with 10cm in diameter and 2m in depth were installed in the

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experiment to measure the water table fluctuation. The wells were placed above the subsurface drains and between them.

b) Subsurface Drainage / Irrigation Operation and Management

Irrigation water is applied to the study area from branch canal to the tank at inlet of field canal at the beginning of the gate pipe and siphons, Figure 1, then flowed to all laterals (field drains) and upward to root zone by capillary flow. The outlet of the collector has drained to main drain. The study has been done by two surface irrigation systems, first by the gate pipes and second by Siphons. The water duty is given for 75% of field capacity.

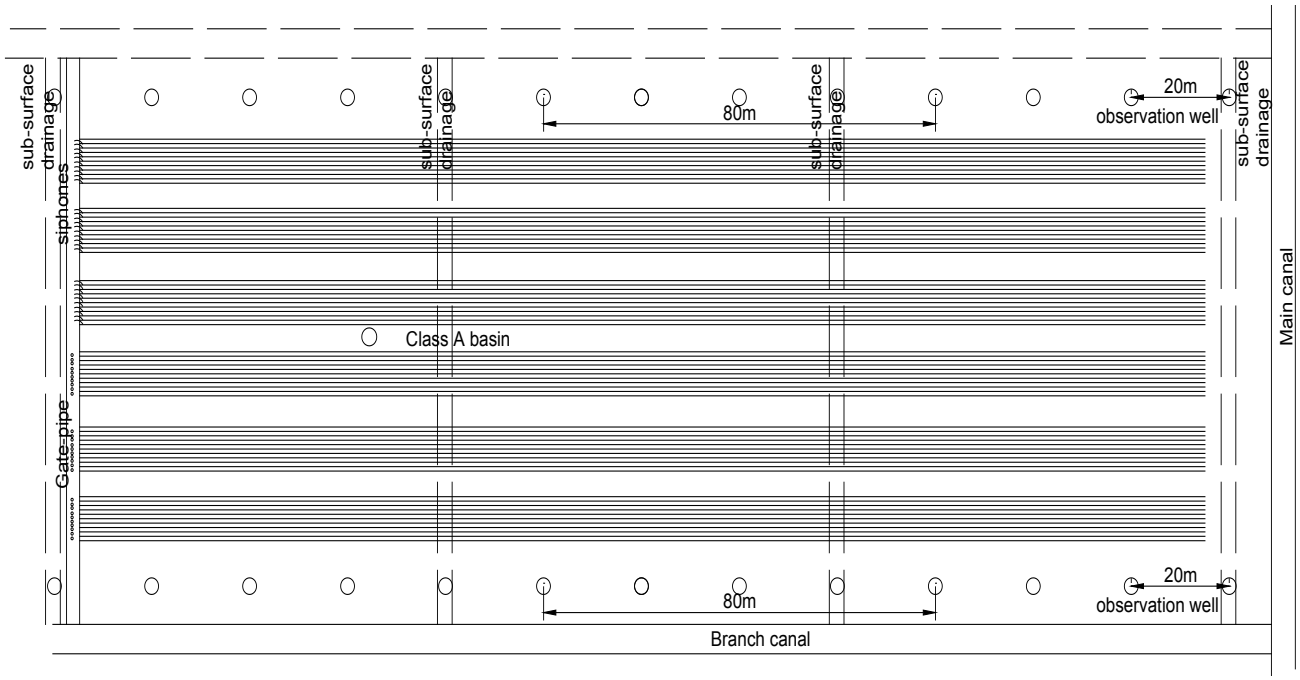

Figure1 : The layout of experimental

c) The Gate Irrigation Pipe

The pipes are 6m in length, 150mm in diameter and with distance holes 0.75m which can communicate with each. The pipe holes can be changed to give the flow required by using the equation 1. Pipe connected with the basin to secure the appropriate pressurized by counter discharge.

$$Q = 2.109 d^2 * h^{0.5} \quad (1)$$

Where Q is the flow "m^3/sec", d is opening diameter "m", h is the water head above the opening center "m"

d) The Siphons System

The siphons with 0.037m in diameter and 1.5 to2.0 m. the equation 2 is used to calculate the flow of siphons

$$Q = K * A * \sqrt{2gh} \quad (2)$$

Where Q is the flow "m^3/sec", A is cross section area of siphon "m^2", g is gravity acceleration "m^2/sec", h is water head "m", K is correction factor.

The water velocity and the water slope were measured at the middle line at each 20m and Parshall flume with 5cm contraction at 3m to 5m from the start line. The class A basin with 121.5cm in diameter and 25cm in height rested on wooden block used to measure the evaporation. Figure 1 shows the layout of the experimental site. The water drained by subsurface drainage 10cm in diameter with spacing 80m and depth 150cm.

e) Measurements

Measurements included water table depth, irrigation and water table salinity, rainfall, temperature and soil salinity.

f) Irrigation water salinity

It was measured before each irrigation gift by a handheld electrical conductivity meter in (dS/m). The equation 3 is used for determine the sodium ratio.

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}} \quad (3)$$

Where SAR is sodium adsorption ration "%", Na^+ is the sodium "meg/L", Ca^{++} is the calcium ratio "meg/L", Mg^{++} is the Magnesium ratio "meg/L".

The equation 4 is used for determine the total salinity dissolved in water.

$$TDS = 640EC_w \quad (4)$$

Where TDS is the total dissolved salts in water "ppm", EC_w is the electrical conductivity "dS/m".

Irrigation water salinity varied from 0.83 to 2.74 with average of 1.78dS/m and sodium adsorption ratio is 2.96% and salts total dissolved salts in water varied from 2331 to 2754 with rate of 2542ppm.

g) Water Table Level

Water table level was measured daily in a set of 26 wells that installed and distributed in between and above the subsurface drainage in the experimental field for both treatments.

h) Soil Salinity

Table (1) shows the average soil salinity for both treatments (siphon and gate pipe) along the soil depth, The table shows that the pattern of soil salinity started with low value of 1.7 dS/m at the upper layer and increases with depth to a value of 3.9 dS/m and this result is confirmed with the logical, where the irrigation water passes through the subsurface drainage system upward by capillary flow.

Table 1 : Soil Salinity

Depth (cm)	E.C (dS/m)	Ca Co3 (meg/L)
0-35	1.7	24.25
35-47	2.95	28
47-105	3.3	22.5
105-125	3.9	22.75

i) Weather Temperature

Weather has been observed daily during the study period and Figure 2 shows the temperature in the study area during the experiment.

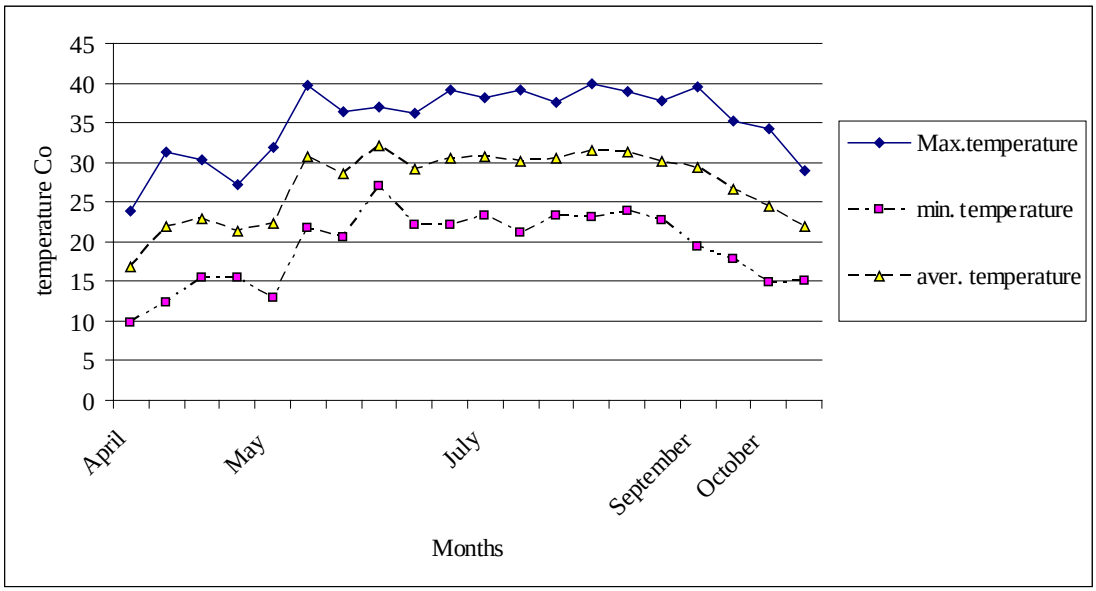

Figure 2 : The weather temperature

j) Crop Yield

The study area were planted in lines 75cm in distance between them and 15cm to 17cm between the plants. Observation of cotton growth was followed and four crop samples were taken from each treatment at harvest time to determine the average cotton crop yield.

III. Results and Discussion

a) Soil Salinity

Table (2) shows the soil salinity for two treatments in all season. The siphon method gives highest value of total salinity at all seasons as shown in Figure 3. This treatment increased the salinity by 2.7% while the pipeline with gate increased the salinity by 12.9%

Table 2 : Soil Salinity for Both Treatments

Treatment		EC_e dS/m	P.H.	Ca mmeq/L	Mg mmeq/L	Na+ mmeq/L	Cl mmeq/L	HCo_3 mmeq/L	So_4 mmeq/L
Siphon	Before Season	4.244	7.65	16.83	14.85	24.11	29.6	0.48	25.7
	Mid Season	4.61	7.6	19.87	16.84	15.85	18.07	0.37	34.15
	After Season	4.36	7.57	14.04	14.89	17.44	20.46	0.37	25.47
Gate pipe	Before Season	3.84	7.7	15.21	12.48	17.04	16.61	0.41	28.85
	Mid Season	4.357	7.51	20.73	15.48	17.39	26.34	0.48	26.81
	After Season	4.336	7.52	15.69	15.11	15.94	19.33	0.37	27.03

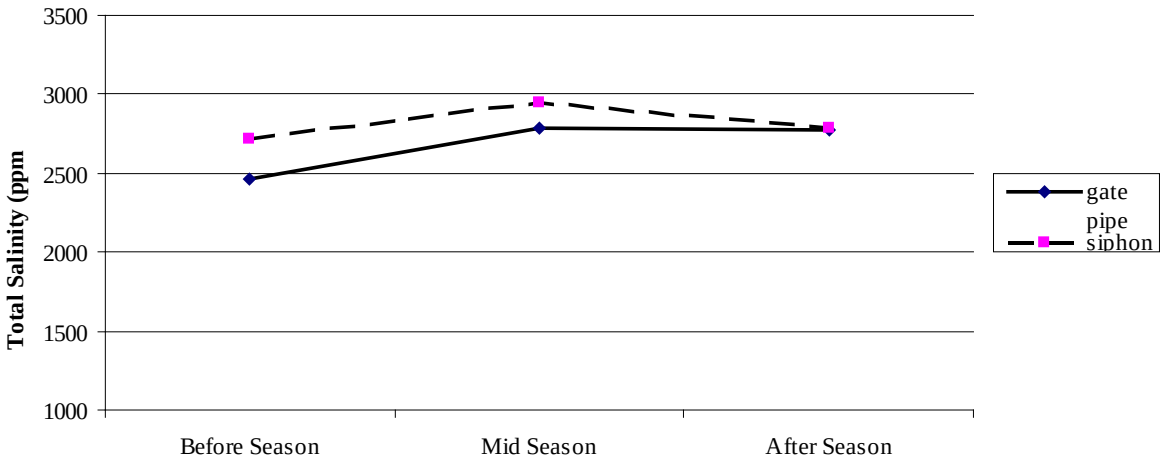

Figure 3 : The total soil salinity

Sodium adsorption ratio (SAR) decreased for all treatment as shown in Figure 4. The pipeline with gate treatment gives lower percentage. The siphon method gives the highest value equal to 24% before season and the lowest one is 17% after season. It decreased the sodium ratio by 27%. The pipe gate decreased the SAR by 6.7%.

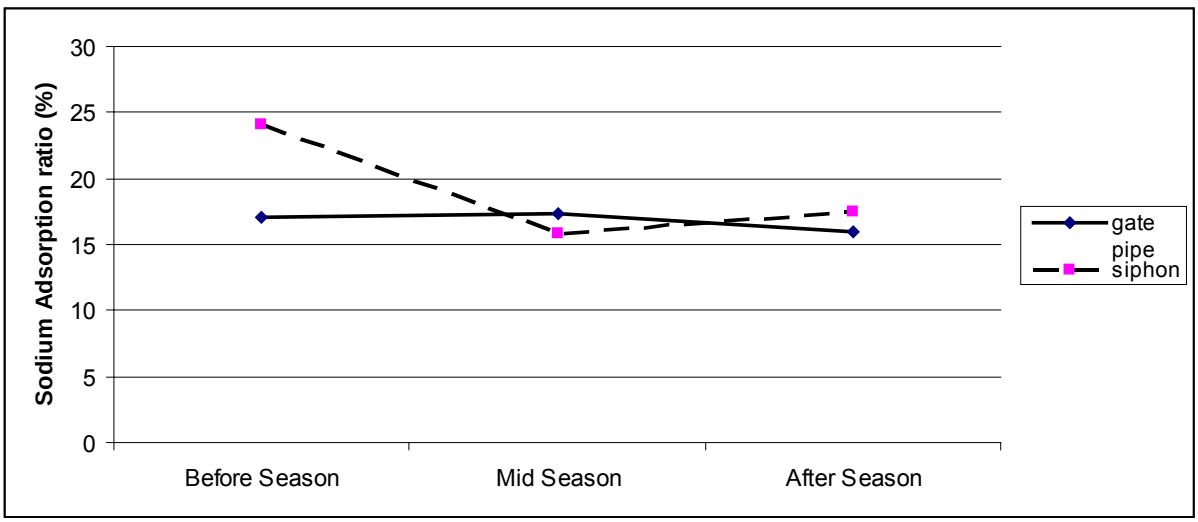

Figure 4 : The sodium ratio for both treatments

Toxic salts (sodium sulfate, sodium chloride and magnesium chloride) changed from 1.8058mS/m before planting to 1.8376 mid agriculture then 1.9695mS/m the end of the season for the treatment of

pipeline with gate. And it decreased from 2.2323mS/m before planting to 1.9113mS/m at mid agriculture then increased to 1.9622mS/m after season for siphon treatment.

Non-toxic salts (calcium bicarbonate and calcium Sulfate) changed from 1.0638 before planting to 1.4366mS/m mid season then 0.9142mS/m the end of the season for the treatment of pipeline with gate. And it increased from 1.1675mS/m before planting to 1.3758mS/m at mid agriculture then increased to 0.8838mS/m after season for siphon.

The probability of producing alkaline soil in all transactions out of the question because the value of $\frac{K+N_a}{Ca+Mg}$ is less than 1. as shown in table (3)

Table 3 : alkaline probability

Season	siphon	Pipe gate
Before Season	0.761	0.61
Mid- Season	0.432	0.48
After Season	0.603	0.453

b) Water Table Salinity

The water table salinity for both treatments was represented in Figure 5. It ranges from 2.45 to 5.37 dS/m with an average value of 4 dS/m for gate pipe treatment while the water table salinity for siphon treatment ranges from 2.3 to 5.25 dS/m with an average value of 3.9 dS/m. It is obvious from these results that there is no difference between the water table salinity for both treatments.

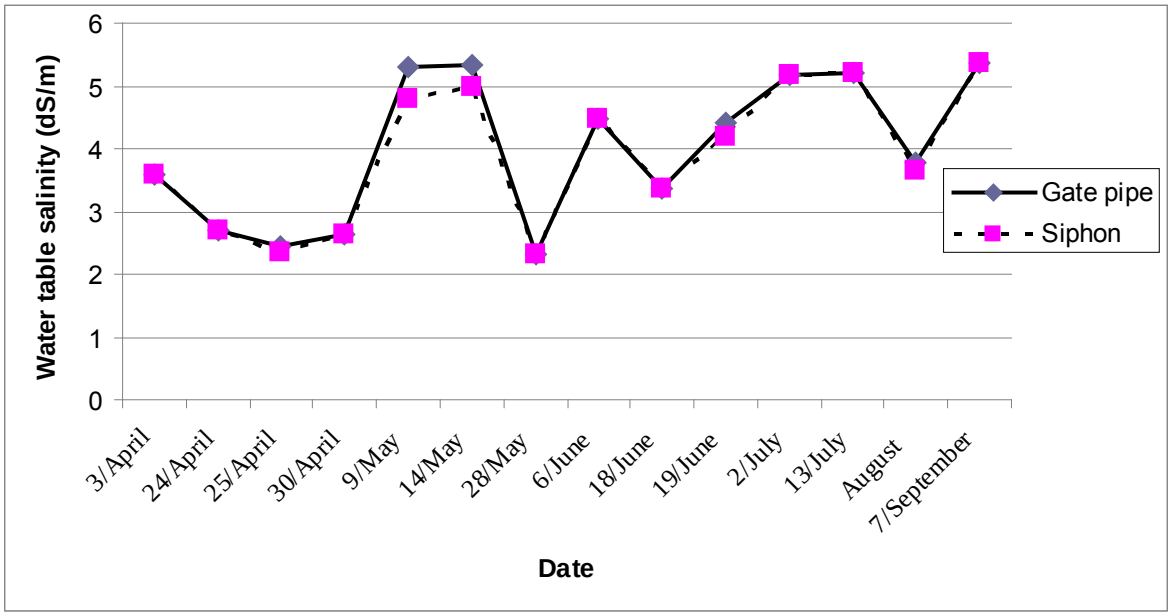

Figure 5 : Water table salinity for both treatments

c) Water table level

The average water table level for both treatments (Siphon and pipeline) along the cotton season are represented in Figure 6.The figure shows that the average water table in gate pipeline is less than in the siphon.

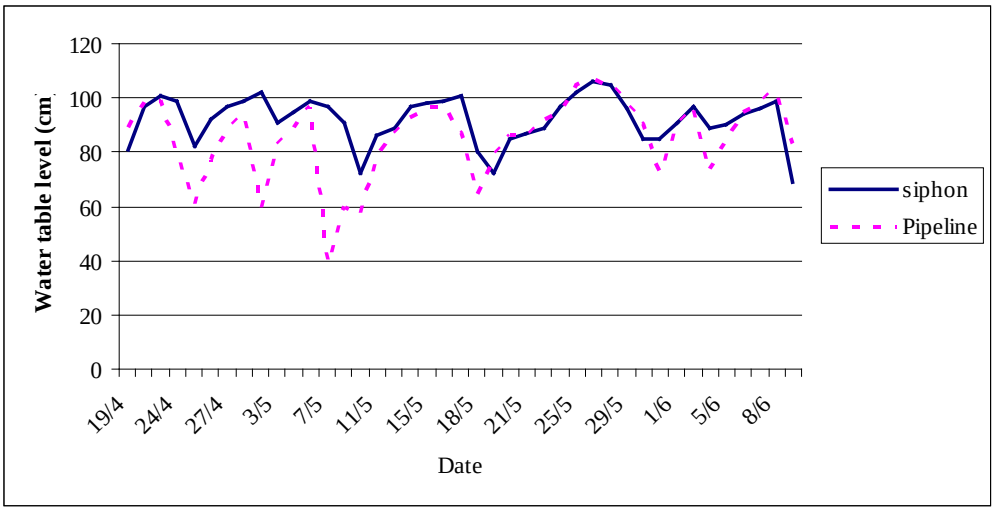

Figure 6 : Water table level

d) Water Consumption

For the gate pipe the water consumption during the flowering phase and form roots gives the largest amount which gives 4200 m^3/hectare (42.4% from the total amount). The germination stage gives 2327m^3/ hectare (23.5% from the total amount), While the water consumption during the floral buds gave the minimum amount. But for the siphon the water consumption during the flowering phase and form roots gives the largest amount which gives 3534m^3/hectare (36.61% from the total amount). The germination stage gives 2340m^3/hectare (24.2% from the total amount), While the water consumption during the floral buds gave the minimum amount equal 893m^3/hectare (9.2%). As shown in Figure 7. The total water consumption for the treatment of pipe gate is 9903 which exceed than siphon by 2.5%.

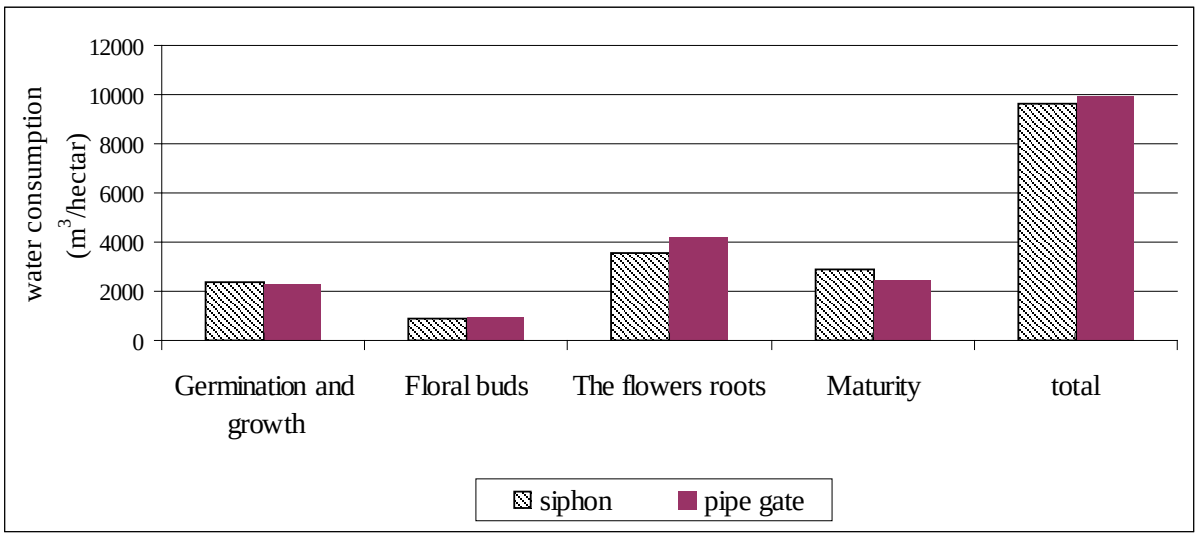

Figure 7 : The water consumption for each treatment

e) Water Irrigation Efficiency

The value of the additional water efficiency was measured by using equation (5) which gives that working in siphons is higher than in the pipeline as shown in table 4.

$$E_a = \frac{D_s}{D_A} \qquad (5)$$

Where E_a is the additional water efficiency "%", D_s is the stored water depth in root zone "cm", D_A is the additional water depth "cm"

Table 4 : Irrigation addition efficiency

Phases	Pipeline	siphon
Germination	56	66
Floral buds	59	67
Flowers	51	66
Maturity of the plant	55	52
Average	55.25	62.75

The water distribution efficiency is higher in siphon 80% than in gate pipeline 72%. The storage coefficient for pipeline is 100% and 99% for the siphon.

f) Time progress

Figure 8 shows the time progress inside the filed. The siphon treatment gives less time than the gate pipeline. The applied time for the treatment of gate pipe is 223 minutes but in siphons is 191 minutes.

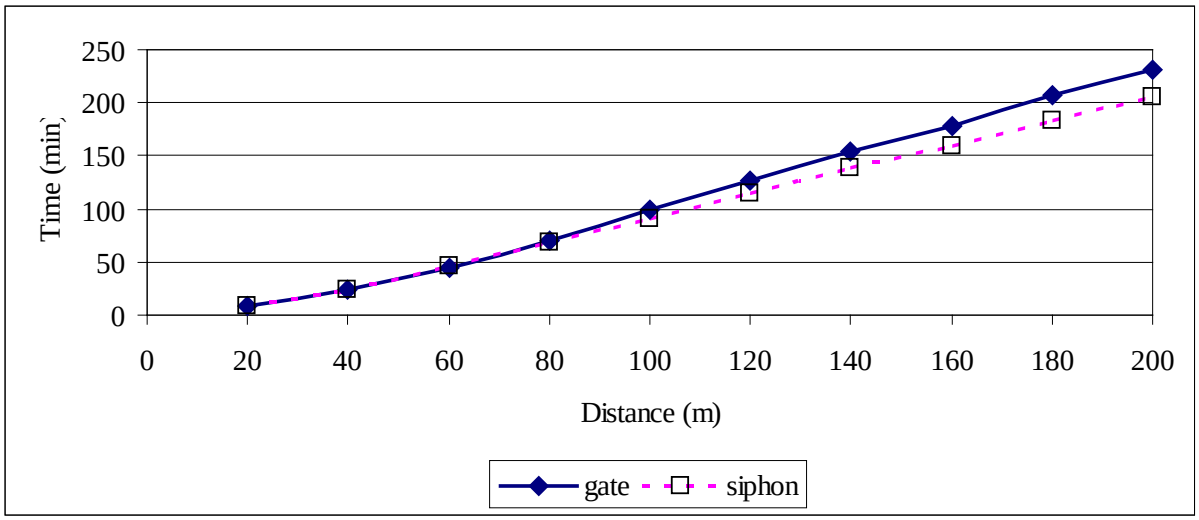

Figure 8 : Time progress in both treatments

g) Crop Production

The crop water need (ET crop) is defined as the depth (or amount) of water needed to meet the water loss through vapor-transpiration. In other words, it is the amount of water needed by the various crops to grow optimally. Convergence the value of the crop coefficient in all relations used in most stages of growth, except Penman relationship which gave the highest values. Figure 9 and Figure 10 show the relation between the crop coefficient and in all stages for gate pipe and siphon respectively.

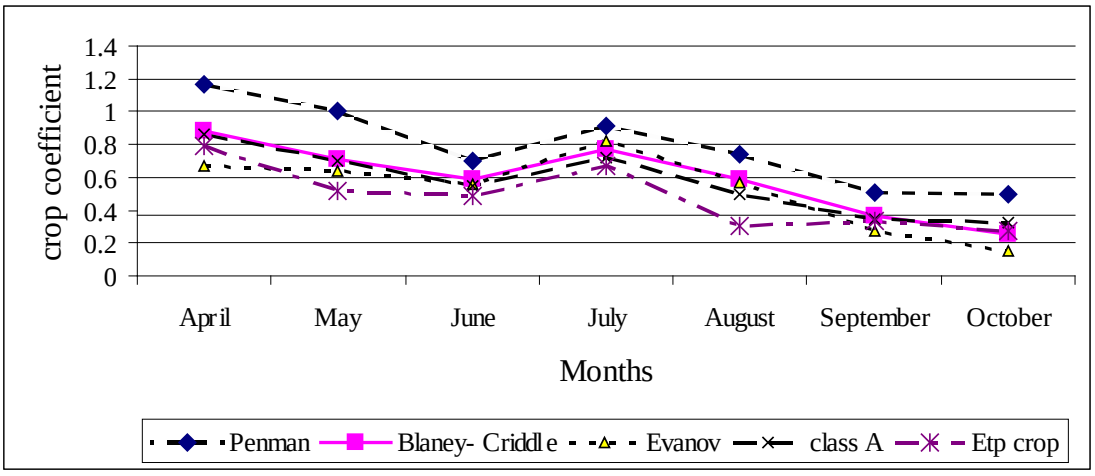

Figure 9 : The relation between the crop coefficient and in all stages for gate pipe

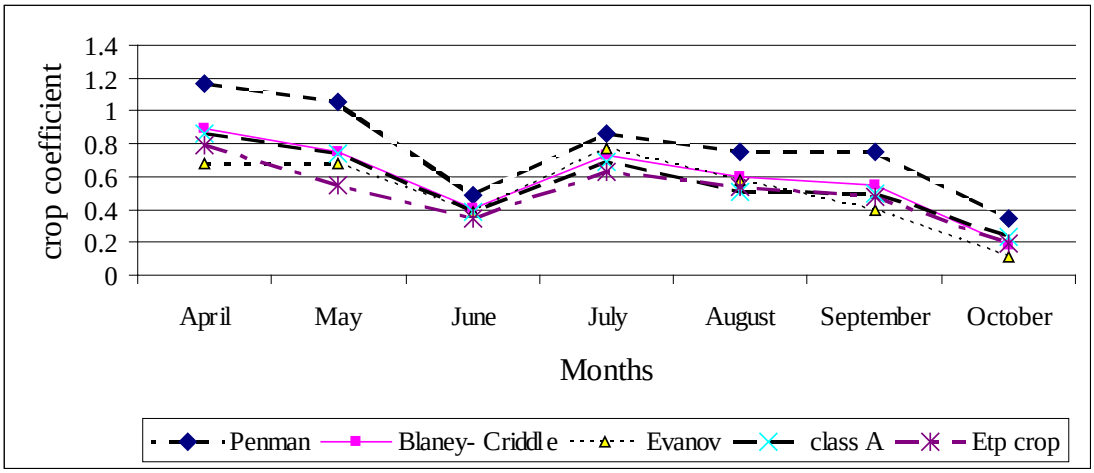

Figure 10 : The relation between the crop coefficient and in all stages for siphon

Table (5) Shows the comparison between the average of the crop coefficient in pipe line with gate and in siphon.

Table 5 : The average crop coefficient

	Penman	Blaney-Criddle	Evanov	class A	Etp crop
$\overline{kc}pipe$	0.79	0.59	0.53	0.57	0.48
$\overline{kc}$ *siphone*	0.78	0.59	0.52	0.56	0.50

Figure 11 shows the average cotton yield for both siphon irrigation and pipeline with gate treatments. In case of gate pipeline treatment, the cotton yield was 2.581ton/ha; this exceeds the yield of siphon irrigation treatment by 17%.

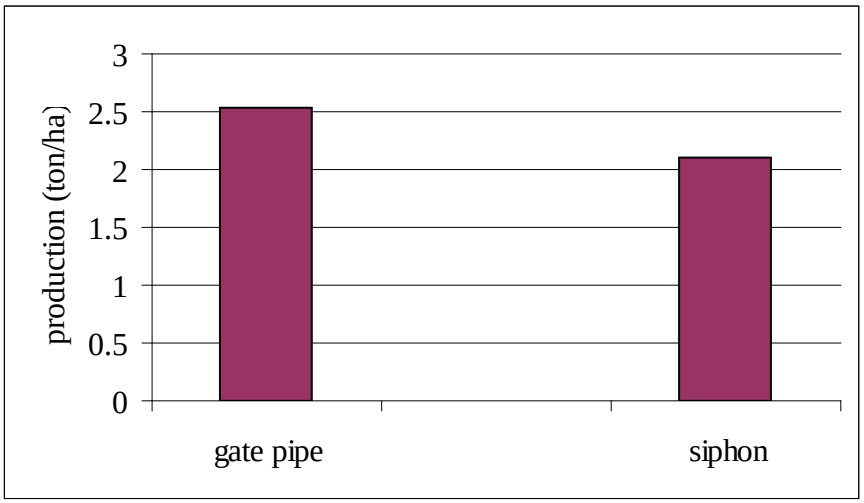

Figure 11 : Crop Production

Figure 12 shows the average cotton length for both siphon irrigation and pipeline with gate treatments. In case of siphon treatment, the average cotton length was 74cm; this exceeds the length of pipeline treatment by 14%.

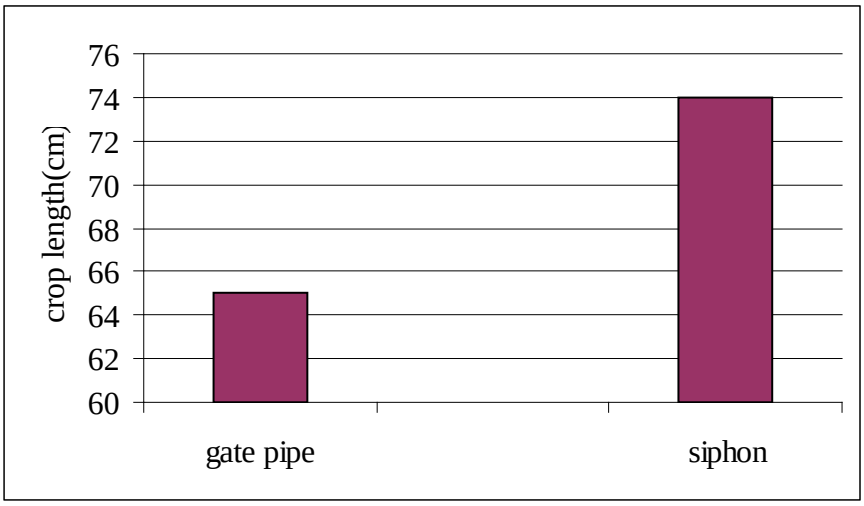

Figure 12 : Crop Length

IV. Conclusion

The total soil salinity increased both treatments. The siphon method gives highest value of total salinity at all seasons which increased the salinity by 2.7% while the pipeline with gate increased the salinity by 12.9%. Sodium Adsorption ratio decreased for both treatments. The pipeline with gate treatment gives lower percentage. The siphon treatment decreased the sodium ratio by 27% and the pipe gate decreased the sodium ratio by 6.7%. The pipeline with gate increased the toxic salts by 9.07% and non-toxic salts by 14% while the siphon decreased toxic salts by 12% and increase the non-toxic by 24%. The probability of producing alkaline soil in both treatments is out of the question. Convergence the value of the crop coefficient in all relations used in most stages of growth, except Penman relationship which gave the highest values. The siphon treatment need water consumption less than gate pipeline by 2.5%. The water distribution efficiency is higher in siphon 80% than in gate pipeline 72%. The storage coefficient for pipeline is 100% and 99% for the siphon. The cotton grains yield in case of gate pipeline treatment was greater than that of siphon irrigation by 17% and equal to 2.581ton/ha. In case of siphon treatment, the average cotton length was 74cm; this exceeds the length of pipeline treatment by 14%.

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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

Index

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