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PROBLEMS OF IRRIGATED AGRICULTURE, NEED REMOVAL TO EFFICIENTLY USE WATER OF INDUS RIVER SYSTEM

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PROBLEMS OF IRRIGATED AGRICULTURE NEED REMOVAL TO EFFICIENTLY USE WATERS OF INDUS RIVER SYSTEM

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The efficient and correct use of the 142 maf of the Indus Water Resources for sustainable irrigated agriculture to produce food and for the economic prosperity of the country is only possible after the removal of its chronic, complicated and dilemmatic problems. The solutions for all the problems of irrigated agriculture in the Indus basin and the initiation of new schemes lie only in implementing integrated comprehensive Water Management (ICWM) in the context of Water Accord. The paragraphs, 2, 4, 6, 12(e) of the water accord collectively mean the implementation of ICWM in the shape of master plan whereas, the IRSA act preamble provides for solutions of maters/problems connected therewith and ancillary thereto the water resources development like the following:

THE PROBLEMS

1. Large-scale salinity and water logging and the wrongly planed drainage scheme like the tube-well oriented SCARP and the ridiculous NDP. Both schemes are worthless due to wrong planning concepts. SCARP is already abandoned. Horizontal surface and sub-surface tile drainage, which is the right solution, is surprisingly ignored. About Rs. 500 billion are wasted on wrong drainage projects since 1962-1963.

2. Misuse of 41 MAF of the drainage effluent ten times the storage of Mangla Dam containing 100 million tons of injurious salts for irrigation of land that added sodicity in soil and increased salinity and Water logging thereby rendering lands infertile, creating famine conditions. About 500,000 small tube-wells are installed so far in Punjab and each year 18000 tube-wells are added. Average quality of groundwater used is of 650 ppm of salt contents but in any areas it varies between 1000 to 2000 Fresh canal water ha about 200 to 250 ppm of salt contents.

3. Wastage of 60% of 142 maf of the surface flows due to lack of Water Management. If waste is saved, it would double the irrigated area. Therefore, there is a need to undertake Integrated Comprehensive Water Management (ICWM) for the efficient use of water.

4. Blockage of waterways of natural surface drains due to encroachments and obstructions aggravating drainage of land on account of constant negligence. It needs revival. At present there is no drainage outlet to the sea.

5. Improvement in rigid, monoculture and inefficient canal irrigation system to match flexible crop water needs for greater yield and sustainable irrigated agriculture. There is a need to replace warabandi system. Introduce Land Consolidation and Land Reform to replace one million miles of the eastern watercourses by pipe supply.

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6. Rapid silting of reservoirs specially Tarbela on the Indus due to poor capacity inflow ratio and lack of watershed management giving poor service value. Water Accord needs 30 maf of storage for its implementation. Storage has to be provided to meet food needs of increasing population.

7. Lack of long life of storage and disregard for Katzara Dam having the world's largest storage reservoir of 35 maf with indefinite life span on the Indus River Katraza is the only storage dam site that can meet the requirements of 30 maf of water to implement the Water Accord but is surprisingly ignored even from investigations since 1962 when it was pointed out to the Ministry of Water and Power and to the then Governor of West Pakistan.

8. The dire need for new irrigation schemes to irrigate Kachi plan in Baluchistan and vast barren areas in other Provinces. Due to non-implementation of the Water Accord, new schemes are delayed by more than 9 years by the inert non-professional heads. They took no initiative to formulate new schemes as per para-V part II of the Water accord. It is shocking that in the modern age of science and technology, specialization and sub-specialization, the non-technical generalists are administering engineering jobs. They have rendered the IRSA Act and the Water Accord ineffective by interfering and mis-reportng IRSA's revolutionary work done in 30 printed reports. There is fear that water war between Sindh and Punjab may soon erupt violently. This is what the minister of Water and Power also feels.

9. Non involvement of engineers at the policy and decision making level has resulted in the accumulation of the above problems and in the execution of wrong drainage, Water Management, storage and irrigation projects. Even the World Bank approved infeasible like SCARP and the NDP by misunderstanding the local conditions, as there was none to guide them at the policy and decision making level.

10. The CCI and the NEC are required to improve economic development through engineers by solving the chronic problems of water use for irrigated agriculture to produce food the basic necessity of life under articles 29, 38(d), 153, 154, 155 and 156 of the constitution of Pakistan and to prepare a Master Plan to implement Water Accord as discussed in this paper.

THE DETAILS

TUBE WELL ORIENTED SCARPs AGGRAVATED WATERLOGGING & SALINITY

One of the major and chronic problems causing food shortage in an irrigated area of about 34 million acres, the world largest, in the Indus basin is Salinity, Sodicity and Water logging. Out of this, about 60% of the irrigated area are affected to various degrees. About 10% of this are "disaster area" where the water table ranges between 0 to 5 feet from the surface. The canal water brings 33 million tons of salts into the Indus

Basin each year. To remove and control salinity and water logging, thousands of tube wells were installed by WAPDA in Punjab during 1962-63 and onward in the name of the so-called "Salinity Control and Land Reclamation Project". SCARP is a misnomer for drainage, as it did not remove salinity and water logging out of the area in 35 years. This is because the very basic concept of the tube well-oriented SCARP is not only wrong but is anti drainage and land damaging in its perception and function.

The tube wells recycle and keep circulating the leached and salty drainage effluent from the ground water for irrigation use. The drainage effluent goes on circulating between the root zone of crops and the topsoil and is not physically evacuated out of the area. The tube well method of SCARP adopted for land drainage and reclamation has no engineering works to collect the leached salts out of the soil and remove it horizontally out of the area. The tube well SCARP can not protect the root development by maintaining salt and water balance, control water tale at specific depth and separate the reclaimed layer from the sub-soil water table as per the technical definition of the drainage of irrigated land widely practiced all over the world. The tube well SCARP miserably failed in achieving the drainage objectives due to its faulty project-planning concept.

Surprisingly, the blunders are repeated on the failure of SCARP, it is replaced by yet another more ridiculous and very wrong drainage project under the new name of National Drainage Program (NDP). It is very sad that SCARPs and NDP both are historic engineering mishaps. These projects are initiated at random and have no essential infrastructures to evacuate salts. There is no arrangement for the drainage and land reclamation. SCARP and NDP are totally devoid of the essential part of drainage to collect the water that leached salts and evacuate it out of the area.

The correct technical definition of drainage to remove and control salinity and water logging and reclaim land for sustainable irrigated agriculture practiced the world over is as follows:

DEFINITION OF DRAINAGE

"Drainage is the essential part of work, collecting the water that leached the salts out of the soil and evacuating it outside the area, as well as separating the reclaimed layer from the sub-soil to avoid raising the water table with the resultant retrogression. Drainage prevents a rise in water table, keeping the later at a depth that will not harm root development. "Drainage is essential for maintaining salt and water balance in the reclaimed layer."

DEFINITION OF LEACHING

"Leaching is the process of dissolving and transporting soluble salts by down ward movement of water through the soil."

It is very surprising as well as shocking that the WAPDA, the Ministry of Water and Power and its renewed consultants has failed to perceive and provide technically feasible drainage-cum leaching works. These are necessary to control and remove salinity and reclaim land according to the above technical definition of drainage and leaching recognized and practiced the world over. Thus SCARP and NDP, both are not provided with the above pivotal works and as such they are inherently bound to fail.

It is awful and extremely disappointing that even the World Bank, I.M.F., Asian Development Bank and other loan giving agencies who provides loans only to feasible projects and expect money to be repaid to them also failed to point out the absurd concept of tube well oriented SCARP. The loan agencies provided loan to an obviously wrong and infeasible project and ignored to recommend works according to the above definition of leaching and drainage as practiced throughout the world. These loan-giving agencies are therefore not entitled for repayment of loan to them as they financed infeasible SCARP that miserably failed and destroyed lands increased salinity, sodicity and water logging and aggravated food problems besides damaging lands. It is understood the World Bank initiated and sponsored the NDP for the Government of Pakistan. This is going to meet he same fate as of SCARPs.

The failure of tube well oriented SCARP is further confirmed by the chairman Federal Public Account Committee (PAC) during the audit of SCARP conducted for the period between 1990 to 1998 (Eight years). The PAC has taken a serious note of the colossal wastage of Rs. 10 billion by WAPDA and the Provinces in the name of SCARP within this period. The PAC remarked, "what a pity that national wealth was stolen giving no positive results". The PAC examined the accounts of the Ministry of Water and Power. It was found that 56 SCARPs were launched at a cost of Rs. 257 billion and all these projects lost their utility. The PAC remarked "such a failure of the projects and loot of national wealth led to a sad situation in which precious agricultural lands were again falling pray to water logging and salinity". The PAC directed to chalk out a proper plan to avert the impending disaster of water logging and salinity. Reference: Frontier Postdated 17.12.1998. So far no proper drainage plan has been chalked out to leach salts out of the soil and evacuate it out of the Indus basin.

As a consequence, land has further deteriorated and famine conditions are developing fast due to wrong policy and decision making by the non-professional bureaucrats. The failure of SCARPs after spending about Rs. 257 billion in 35 years that aggravated salinity is a great national calamity and a colossal engineering mishap for which the Ministry of Water and Power and WAPDA are responsible. Moreover, the loan giving agencies are also to be questioned for funding infeasible projects. Therefore, there is a dire need that the National Economic Council (NEC) may examine the failure of SCARPs as famine conditions have developed. This has to be averted by initiating feasible drainage schemes as per its technical definition given above and as desired by the PAC. The NEC may also re-examine the feasibility of the NDP as it has a very wrong and ridiculous project-planning concept. The second wrong drainage project would destroy the Indus Basin.

Even after the shocking failure of SCARPs and the country already faced with 20 percent wheat storage besides other foodstuff, the matters are not taken up seriously. Moreover, the experts of the Ministry of Food and Agriculture and the Ministry of Water and Power have no coordination in the development of sustainable irrigated agriculture. The agricultural scientists on there own are searching biological method to grow salt resistant shrubs and trees in saline areas and use lands that way. They forget that the population is not going to eat saline resistant shrubs and trees and leave vast areas stay saline for growing salt resistant shrubs and trees. The agricultural scientists are not searching to prevent the causes of salinity and water logging so that land is reclaimed to grow food crops for human consumption. In this very context, it is shocking to know the disappointing views and findings of the National Commission on Agriculture (NCA) on page 296, para 17.33of their report which states that: -

"Saline soils and ground water are facts of life and we have to live with them."

Irrigated agriculture can never "live with saline soil and ground waters." Irrigation engineer through simple drainage that will reclaim that will reclaim land reverse these "facts of life."

The above remarks made by the NCA show complete ignorance at a very high level. These remarks lead astray and divert attention from the real solution. The conclusion drawn by the NCA is very wrong and misleading, as there is a sure and perfect engineering method to control salinity and water logging and reclaim land for irrigated agriculture on sustainable basis. The recognized engineering method to control salinity and water logging is to provide "horizontal surface and sub-surface tile drainage". This method is the practical translation of the technical definitions of drainage and leaching both into engineering works. This simple method ensures proper soil environment for agriculture development and is a vital engineering input for irrigated agriculture.

In fact, irrigated agriculture is a modern science, the science of survival and not an art. It therefore needs very close coordination between agricultural scientists, agronomists, soil scientists and irrigation engineers to develop irrigated agriculture on sustainable basis to feed the ever and rapid growing population. Irrigated agriculture needs vital engineering structures of horizontal surface and sub-surface tile drainage at the Indus basin level to collect the water that leached the salts out of the soil and evacuate the effluent out of the Indus basin. The horizontal surface and sub-surface tile drainage protects root development of crops, maintains salts and water balance, controls water table at specific depths and separates the reclaimed layer from the sub-soil water table.

Besides the drainage, the irrigated agriculture needs another vital infrastructure comprising of the flexible and assured canal irrigation system at the Indus basin level to make water available as per crop consumptive use as and when needed in proper doses. These two basic infrastructures or the inputs are pre-requisites for the development of sustainable irrigate agriculture in the Indus basin as one whole. The Indus basin is a single hydrologic unit with contiguous irrigated area. This needs an efficient net work of

irrigation system and a matching horizontal surface and sub-surface tile drainage system for the basin as a whole controlling and regulating the use of an inflow of about 142 maf with residual drainage effluent available as out flow below Kotri to the sea.

Unfortunately, the Ministry of Agriculture and its organizations with hundreds of Ph.D. and M.Sc. in the PARC never demanded these basic physiological and agronomic requirements for agricultural development as vital engineering inputs from the Ministry of Water and Power, WAPDA and the Provinces. The experts of both the Ministries are lurking in dark and are working independently in opposite as well as wrong directions. This is one of the reasons for deteriorating irrigated agriculture and food shortage in the country. Last year 4.1 million tons of wheat was imported which means the country is faced with partial gamine up to 20 percent. Wheat and other foodstuff worth $ 2.5 billion or Rs. 130 billion on the average are imported each year. Lands in the Indus basin are fast deteriorating due to salinity, sodicity, water logging, and misuse of salty drainage effluent and gross water mismanagement. On the other hand population is rapidly increasing. The non-professional heads of engineering departments have failed to handle the situation during the last 30 years. Therefore famine conditions are invisibly and gradually developing. Food is the necessity of life as provided in articles 38(d) of the constitution, therefore, the NEC should take special care for the proper development of land and water resources to produce food to feed the population. This needs a technically sound Master Planning.

The land damaging and harmful function of tube well method of SCARP using salty drainage effluent to supplement canal water for irrigation instead of evacuating it to the sea has been copied and adopted by the private sector for the irrigation of their land. This aggravated salinity and added sodicity in soil. The details of the misuse of drainage effluent in private sector as a consequence of SCARP are: -

MISUSE OF DRAINAGE EFFLUENT TEN TIMES THE STORAGE OF MANGLA DAM INCREASED SALINITY AND ADDED SODICITY

The misuse of drainage effluent for irrigation as a follow up of faulty tube well oriented SCARPs is yet another of the disastrous by-product. This is because the farmers of Punjab in private sector have installed about 500,000 small tube wells. They started unrestricted use of the leached and salty drainage effluent containing about 100 million tons of injurious salts is pumped from the blocked and accumulated groundwater effluent and is used as additional major source of irrigation in Punjab. This injurious as well as illegal practice has further aggravated salinity and water logging and added sodicity in soil of Punjab. It has destroyed fertile lands. This is the reason that the Canal and Drainage Act of 1887 prohibits the use of leached and salty drainage effluent for irrigation and does not permit interference with the flow of drainage effluent. However, the Act is forgotten and the injurious drainage effluent equivalent to 10 times the live storage capacity of Mangla dam is freely used on land in Punjab.

The Canal and Drainage Act is further ignored as almost all the natural surface drains and their waterways are blocked due to encroachments, obstructions, and lack of maintenance and lack of supervision. This aggravated salinity and water logging. Therefore, there is a dire need to revive the flow in the drains by restoring their original waterways before implementing any drainage project in the Indus basin. At present there is no drainage outlet to the sea. For the design of drainage system in the drainable surplus is first reduced to the minimum possible limit at the source permanently. This basic requirement has not been met. Tube well-oriented SCARPs followed by the enormous use of the salty drainage effluent both have created adverse conditions for irrigated agriculture in the Indus basin. The later has added more sodicity in soil. Both these wrong practices have aggravated salinity, sodicity, water logging and infertility of land. Their operation is anti-drainage. In spite of these wrong practices and their damaging effects on land and agriculture, the Ministry of Food and Agriculture has shown no concern although the National Agriculture Policy of 1988, page 26, para. (d) And (e) made the following observations: -

Para (d) "Main problem is sodicity covering about 1.7 million hectors or about 4.2 acres"

Para (e) "Out of 40 maf of water pumped annually by tube wells, about 50 % Causes sodicity in the soil."

The National Drainage Program (NDP) replacing SCARPs is yet another planning blunders of salinity and sodicity aggravation that would prove to serve as the last nail in the coffin of irrigated agriculture in the Indus Basin. As a consequence or repeated blunders of SCARPs, followed by the use of drainage effluent and then by the NDP, famine is bound to come. However, it is a formidable task for the National Economic Council (NEC) to control and reverse the havoc already done. Besides the above, huge seepage losses of about 52 maf from the canal irrigation system are to be avoided as that is the cause of salinity and water logging. This too is a formidable task. Moreover, besides seepage losses, there are waste of flows of about 35 maf due to floods that cause havoc to land and infrastructures. This has to be controlled by storage for the efficient use of the Indus Water Resources. The solution to all these problems lie in Integrated Comprehensive Water Management (ICWM).

The Government of Pakistan should learn a lesson that the failure of Agriculture has broken Russian Empire to pieces. The same will be the consequence of Pakistan if the Government fails to take serious notice of its fast deteriorating land, water and irrigated agriculture in the Indus Basin. The country is already faced with partial famine and its yearly food import bill is about 2.5 billion dollars.

LOSS OF 60% OF 142 MAF OF THE INDUS WATER DUE TO GROSS WATER MISMANAGEMENT

In fact, the greatest of all the problems of irrigated agriculture in the Indus Basin is of 60% of water wastage due to gross water mismanagement that has caused salinity and water logging, besides wasting life saving water. The Federal and Provincial Governments have never paid attention to save water to minimize waste flows by water management, as this is the first essential requirement before taking in hand any drainage projects. Besides this, there is acute shortage of water and the Water Accord of 1991 specifically provides in para 14(e) that all wastage must be avoided. The efficient use of 142 maf of the total inflow for irrigated agriculture including the 105 maf of water diverted into the inefficient canal irrigated system in the Indus Basin therefore vitally needs integrated comprehensive Water Management. At present, there is a colossal wastage of about 52 maf of water due to seepage from the unlined and inefficient canal irrigation system and from the wasteful and inefficient agricultural and irrigation practices. Drainage of land is not practicable under the prevailing wasteful conditions. Therefore, as a first step, the waterways of the blocked natural surface drains in the Indus basin should be restored to their original form. This would also facilitate the laying of sub-surface tile drains.

Similarly, about 35 maf of the surface water is wasted to sea during floods on the average each year. The total wastage of fresh surface water comes to about (52+35) = 87 maf, out of the total inflow of fresh surface water of about 142 maf which is twenty times the storage of Mangla Dam. The total wastage comes to about 60%. This is shocking and proves utter failure and incompetence of the concerned agencies both at Provincial and Federal level.

According to the preamble or IRSA Act, t he problem of huge wastage of water is very vital "connected matter" to the development of Indus Water resources and therefore it has to be solved by implementing ICWM. Moreover, the Water Accord papa 14(e) provides that "All efforts would be made to avoid wastage." In compliance to the above provision of the IRSA Act and the Water Accord, seepage and flood wastage of about 60% are to be avoided as far as possible and preserved for bringing new areas under irrigated agriculture. This huge quantity would need a number of storage dams that are needed to regulate and monitor 142 maf of the total inflow of the Indus water resources. Besides this, there is am immediate need for the collective water requirements of the Water Accord to implement its vital para 2,4,6,12, and 14(e).

DELAY IN FORMULATION OF NEW IRRIGATION AND STORAGE SCHEMES AS REQUIRED UNDER PARA-V OF PART-II OF THE WATER ACCORD

In the wake of settlement of the Indus waters, the Water Accord para-V of part-II provides to formulate new schemes in agriculture sectors both for implementation over the next two years and during the 8th Five Year Plan period. About nine years of the Water Accord have passed, but no action is taken. Even the desk studies for implementing vital paras of the Water Accord have not been taken in hand so far. The Water Accord is therefore virtually rendered ineffective by the Ministry of Water and Power in spite of IRSA's numerous reports and directions to activate vital plans of the Water Accord. The Provincial and Federal Government both have miserably failed to start the implementation of Water Accord in their capacity as policy and decision-makers. After the Water Accord agreement in 1991, it was essential for the policy and decision-makers to have started the planning and executing of ICWM. The preamble of IRSA Act and the collective paras 2,4,6,12 and 14(e) of the Water Accord part-I and para-V of part-II require this. ICWM needs sound planning for the useful and efficient use of the entire 142 maf of the surface water. The horizontal surface and sub-surface tile drainage, long life storage and efficient canal irrigation system form vital and main components of ICWM.

The Water Accord allocation to the Provinces under para 2 is 117.35 maf of water where as the actual canal diversions of existing uses is about 105 maf. Therefore there is an inherent deficiency or shortage of water of about (117.35 – 105) = 12.35 maf which has to made available by creating new storage at the earliest so as to make para 2 fully operative. The Water Accord para12 provides that the drainage requirement for leaching salts will be met out of flood supplies as provided in para 4 in accordance with the agreed sharing formula. WAPDA has started the NDP and its major components of LBOD for the last few years but it has failed to workout the exact quantity of water that is needed for leaching salts. WAPDA did not intimate its requirements to IRSA as required under section 8(g) of the IRSA Act and para 12 of the Water Accord. Roughly, the quantity needed is assumed, as 5 maf that needs to be stored and released when needed. In addition to the above requirements, Tarbela and Mangla reservoirs have lost about 6 maf of their gross storage capacity. This shortage needs to be urgently replaced. In the next 15 years, till the storage is built if started now, there will be another loss of storage capacity of about 6 maf. As such, the total immediate water requirements of the Water Accord is (12.35 + 5 + 6 + 6) = 29.35 maf say 30 maf, which needs the initiation of schemes. The Government has badly failed to build the second dam on the Indus even after a quarter of a century. This is the height of poor management and lack of understanding to oversee the dire need for storage to avert famine. On the contrary, the delay in storage created political problems and technical difficulties besides loss of agricultural production and he need to import food.

Poor administration caused collapse of Water and Power wings of WADA. Power theft on a large scale was not prevented that caused artificial shortage of power, load shedding,

loss of revenue and the scandalous induction of IPP. Good administration by the army in a short time recovered huge arrears, checked and prevented power theft and made available surplus power of about 3000 MW. This shows man behind the gun counts.

Before planning and executing National Drainage Program (NDP), the failure of SCARPs, the blocked natural surface drains, the colossal use of 41 maf of the salty drainage effluent of the ground water with 100 million of injurious salts and the huge waste flow of 52 maf as seepage from canal irrigation system and 35 maf of waste flood flows must be kept in view as these problems need prior solutions. The above factors necessitate reconsidering the present project-planning concept of the NDP, as under these adverse conditions how would it be possible to implement NDP. It is the height of ignorance that non-professionals discuss NDP in technical conferences. If this practice continues, take it for granted that water resources development is not in safe hands and the past 35 years experience proves the same.

NDP YET ANOTHER BLUNDER AFTER SCARP

Before starting the NDP, the causes of failure of SCARP and the name of its author has not been investigated. The fallacious SCARPs are abandoned and replaced by a more ridiculous and harmful project under the new name of National Drainage Program. This too has no essential part of the work to collect the leached salts and evacuate it outside the area. The NDP is a 25 years plan, covering the whole of the Indus Basin, costing billions of dollars. It is strongly suggested that the feasibility of NDP must be reinvestigated in the light of views as given above by the World Bank who is sponsoring it before wasting huge money and time. Like SCARP, in case of NDP, its project-planning concept is wrong. Reference may be made to the definition of drainage, which the World Bank knows very well. The same has not been followed while planning SCARP and NDP.

The first and the basic mistake committed in the NDP is that before undertaking any drainage projects it is an established principle "to first of all reduce the drainable surplus to the minimum possible limit at the source dramatically and permanently." This has never been done in case of SCARP, as well as in case of NDP. Even the blocked waterways of the natural surface drains have not been restored to release the drainage effluent. This is the first blunder committed in implementing SCARP and NDP.

About 55 maf of the drainage effluent s blocked in the Indus basin each tear. The seepage water from Canal Irrigation system and the wasteful agricultural and irrigation practices contribute about 52 maf each year. Moreover, floodwater also contributes from its 35 maf going waste to sea each year. Rainwater contribution is in addition to this. All this drainable surplus is to be reduced as much as possible to reduce the size of drainage project and is cost besides saving precious water going waste.

Moreover, the blockage of surface drains, interference with the flow o drainage effluent and the use of drainage effluent for the Canal and Drainage Act of 1887 prohibit

irrigation. Natural surface drains are to be properly looked after like canals and their waterways revived.

The second blunder committed in the execution of the NDP is the installation of thousands of scavenger tube wells in Lower Sindh. This is the most ridiculous component of NDP as it is absurd and purposeless if looked in the light of the definition of drainage. Under the NDP, thousands of scavengers tube wells 250 feet deep are installed. The scavenger tube wells extract highly saline drainage effluent with salt concentration up to 55000 ppm that is nearly twice as saline as seawater. Seawater has about 25000 to 30000 ppm of salt concentration. This highly concentrated salty effluent lying 250 feet deep is extracted and is carried in hundred of miles of earthen watercourses to sea for disposal in Lower Sindh. The concentrated salty effluent on their way seeps and spoils the land through which it passes. This aggravates salinity. The objective of this strange operation is not understood except waste of money and land besides creating more salinity problems. According to the definition of the drainage for irrigated agriculture, the maximum depth of drainage is confined to 7 to 8 feet below the top surface to protect root development of crops. At this depth or a little higher, sub-surface tile is laid horizontally to collect the leached drainage effluent out of the soil and evacuate it. The root area only is to be protected from excessive salts and moisture. Beyond the root depth of crops and below the horizontal sub-surface tile drain agriculture has no activity and function and does not need any engineering infrastructure or underground deep operation like the scavenger tube wells.

The third blunder of the NDP is to conduct experiment to grow salt resistant shrubs and trees in a saline area of 100,000 acres a cost of Rs. one billion. The agricultural scientists call this as the biological method to overcome salinity and water logging. The basic concept of the biological method is wrong, as it cannot evacuate salinity out of the area and cannot reclaim land for crop growth and agricultural activity. No one eats shrubs and tress and no one wants that the area should stay saline. What is needed is to physically remove the basic causes of salinity and water logging and then provide engineering works to collect the leached salts out of the soil and evacuate it outside the area, control water table and maintain salt and water balance. There is a sure engineering solution to the problem of water logging and salinity by providing horizontal surface and sub-surface tile drainage. Why the method was avoided in case of SCARP and now in NDP is a dilemma. Moreover it shows utter failure of administration at the policy and decision-making level where there is no technical understanding and check to clear the project-planning concept before its execution.

The fourth problem to have been tackled or kept in view by the NDP before its commencement is highly complicated and most dilemmatic. The planner had never thought that it would not be practicable to implement NDP in Punjab without first solving many complicated issues developed there. The greatest dilemma is the use of 41 maf of the salty drainage effluent with 100 million tons of injurious salts for the irrigation of land, which is ten times the storage of Mangla dam. How would it be possible to evacuate this huge salty effluent when it has become the major source of additional water supply for the irrigation of land in Punjab? The formers of Punjab use saline sodic drainage

effluent in addition in addition to the canal water. The salty drainage effluent cannot be spared for evacuation out of the area under the NDP. Therefore, the problem of salinity and water logging would stay. The source of 41 maf of drainage effluent being used is the seepage water of about 52 maf from the canal irrigation system and its wasteful practices, which cannot be stopped at the source. This is because; the drainage effluent has become the source of recharge of groundwater, which is used for irrigation by Punjab. Under such complicated conditions, the inefficient and seeping canal irrigation system and its highly wasteful practices cannot be improved and modernized to reduce the wastage. The wastage or the drainage effluent has become the source of recharge for groundwater.

At present, Punjab uses two major sources of water supply for irrigation. The first source is 55.94 maf of the fresh surface water allocated as the share of Punjab in the Water Accord. The second major source of water supply is the salty drainage effluent of about 41 maf of water with 100 million tons of injurious salts. This drainage effluent is accumulated as groundwater and is pumped through about 500,000 small tube wells for irrigation use. The total use of water by Punjab for irrigation comes to 55.94 + 41 = 96.94 say 97 maf.

In view of such a dilemmatic situation how is it possible to evacuate the drainage effluent under the NDP when it is used for irrigation in Punjab? If the drainage effluent were allowed to continue for the next about 20 years, then most of the land in Punjab would become saline waste.

Alternatively, if the 41 maf of the drainage effluent is not used and is evacuated by the NDP, then Punjab would need additional water to replace drainage effluent, which is not available under the Water Accord. This is another self-imposed problem. If Punjab stops using 42 maf of the drainage effluent and does not evacuate it then in that case there would be a quick rise in the water table of at least 2 feet each year. This alarming rise in water table can convert irrigated area in Punjab into disaster area. Punjab is therefore caught between the devil and the deep sea.

Punjab is the heart of irrigated agriculture and the source of food supply. It must be saved from ruination due to repeated wrong planning to avoid famine in the country. No drainage scheme can be successful except, the horizontal surface and sub surface tile drainage that is adopted all over the world for land under irrigated agriculture. This is the method that collects the leached salts and physically evacuates it out of the area. The solution to the dilemmatic problem in Punjab only lies in implementing Integrated Comprehensive Water Management (ICWM) as per its definition given below in which the horizontal surface and sub-surface tile drainage forms part of it. Drainage is already defined. Like drainage, all those who deal with it also misunderstand Water Management. Therefore its technical definition is given under the next heading of ICWM.

The World Bank and other participants who provide loan to a number of obviously infeasible water projects for agricultural development have raised doubts that the Bank instead of giving help and expert advice means to pauperize the country rather to achieve

self sufficiency in food. It appears the loan is used as commercial weapon and the non-professionals, who accepted it, are influenced by the loan agencies.

SOLUTIONS TO ALL PROBLEMS LIE IN ICWM IN SHAPE OF A MASTER PLAN

A permanent solution to all the problems and dilemmas lie in implementing Integrated Comprehensive Water Management (ICWM) for the efficient use of about 142 maf of the total surface water resources of the Indus River System. This can irrigate a gross area of about 50 million acres in all the four Provinces. This can be planned in the context of the Water Accord and the preamble of IRSA Act in 50 years Maser Plan. The implementation of ICWM shall have to follow its technical definition given as follows: -

DEFINITION OF INTEGRATED COMPREHENSIVE WATER MANAGEMENT (ICWM)

"It is defined as the integrated process of watershed management, storage, diversion, conveyance, regulation, measurement, distribution and application of the rational amount of water at proper time and removal of excess water from the farm to promote increased production economically in conjunction with improvement of agricultural practice and institutional arrangement."

According to the above definition of ICWM, it is evident that its major components are the assure and regulated water supplies which is only possible through storage in a flexible modernized, and efficient canal irrigation system. This would need a proper arrangement for regulation, measurement, distribution and application of rational amount of water at proper time and an effective drainage system to remove excess water from the farm to promote increased production with improved agricultural and irrigation practices. The ICWM should therefore be truly implemented according to its definition through its engineering components of drainage works, storage dams and an efficient and flexible canal irrigation system with essential Land Consolidation in area under irrigation. Land Consolidation in regular plots is a prerequisite for Water Management to lay network of pipe and farm roads.

The ministry of Water and Power and WAPDA never conceived and planned to implement water management in the Indus basin according to the above definition but wasted huge money on phony and piece meal works in the name of Water Management as in case of SCARPs and NDP. If ICWM is truly implemented, there would be no trace of salinity and water logging and irrigated agriculture would be established on sustainable basis in area of about 50 million acres of land in the Indus basin. If sprinkler and drip irrigation methods are used then more area could be irrigated.

On implementation of horizontal surface and sub-surface tile drainage in the Indus basin as part of the ICWM, the drainage effluent as outflow after a few years of leaching salts in the soil up to a depth of about 7 feet or lesser than that would go on improving its

quality from year to year. A stage will come when this involuntary flow as drainage effluent in the lower Indus basin could serve some useful purpose. This flow, which could be substantial, would also be supported by the irrigation return flow. This may fulfil Sindh's traditional demand for free flow of Indus water down stream of Kotri Barrage to feed Indus deltaic region and its ecosystem.

The drainage, a vital component of ICWM has already been discussed in the context of SCARPs the NDP giving its correct definition and functions to evacuate salts. The other two vital components of ICWM are the supply of irrigation water through "efficient and flexible canal irrigation system", and the construction of "long life storage" to support flexible supplies in canal irrigation system. The shortcomings and problems of rigid, mono culture and inefficient canal irrigation system and the obsolete method of the supply of water to crops according to WARABANDI are discussed first.

IMPROVEMENT IN EXISTING INEFFICIENT CANAL IRRIGATION SYSTEM

The existing unlined and wasteful canal irrigation system, the largest in the World, was designed on the basis of an empirical formula developed by Engineer Lacey about 120 years ago. The Lacey's canal was designed to carry fixed and constant discharge for mono culture irrigation with fixed cropping pattern in a ratio of one Kharif and two Rabi (1:2) with 70% intensity of irrigation. Such rigid conditions no longer exist and can never be practiced. The above restrictions were placed with the idea to equate Kharif discharge with Rabi discharge so that the canal has a fixed discharge to maintain regime flow conditions. As fixed canal discharge is no longer compatible to meet the varying crop water needs of higher intensities of irrigation therefore it needs improvement to make the varying crop water needs of higher intensities of irrigation therefore it needs improvement to make it compatible to increase crop yield per acre and make agriculture more profitable.

Lacey designed a non-silting, non-scouring rigid flow canal to maintain regime flow so that the canal section remains stable. The regime conditions necessities that for a given fixed discharge, the velocity, the bed slope, and the cross-sectional area of canal are all fixed. Therefore, any change in discharge would affect other design parameter and disturb the regime flow. This will result in the silting of canals.

In actual practice, silting takes place in all canals therefore, there is annual silt clearance every year. The silting shows that Lacey's canal is not maintaining its regime as mostly the discharge varies and fluctuates to meet the varying crop water needs. This is because it is no longer practicable to strictly follow the originally assumed Karif-Rabi ratio and the assumed low intensity of irrigation and keep the discharge constant as well as the canal cross-sectional area. The crop water requirements do not want a fixed and rigid discharge as the water requirements as per crop consumptive widely vary during the various stages of crop growth. As such, fixed canal discharge has become incompatible with water need of crops to satisfy their physiological needs. It therefore needs fluctuating discharges in a ratio of one minimum and four maximums (1:4) for higher

intensity of irrigation of about 170% during the various stages of crop growth. The fixed discharge is either short of crop water requirements or it is surplus and is wasted. Moreover intensity of irrigation and cropping pattern has undergone drastic changes.

It could be one of the reasons that Punjab out of consumption started the use of drainage effluent to raise the intensity of irrigation that needed additional water at times when required most but was not available in canal. The farmers of Punjab adopted more profitable cropping pattern and higher intensity or irrigation so as to achieve maximum benefits from the interaction of land and water use and from the drainage effluent in the shape of groundwater what was easily available to all farmers at the farm for irrigation.

The farmers considered very essential to make the best use of land and water to make agriculture profitable. This requires higher intensity of irrigation, better cropping pattern which needs more water on the basis of crop consumptive use as and when needed so as to satisfy the physiological needs of crops during its various stages of growth.

Under the present circumstances, agricultural practices have under gone drastic changes than originally assumed by Lacey. Under such conditions, monoculture, low intensity canal cannot meet the water requirements of high intensity of irrigation and better cropping pattern. Therefore, there is a need that the canal discharge and its design should be synchronized and made compatible with the flexible agricultural water requirements during the various stages of crop growth. It is no longer practicable to restrict agriculture as required by Lacey's canal for the sake of maintaining the theoretical regime flow conditions. In actual practice the design discharge never remains constant but fluctuates. This reduces silt-carrying velocity of flow and silting takes place. Once the canal gets silted, then it is not capable to carry the original design discharge and there is shortage of water. At times, the canal cross-sectional area widens, which again reduces the silt carrying velocity and causes silting of canal. Presently, the monoculture low intensity canal is used for high intensity irrigation. It therefore cannot meet the physiological crop water requirements in time and in proper doses. This incompatibility is not an ordinary matter as crop yield per acre is highly reduced due to wilting or crops for not receiving proper doses of water in time. Therefore, there is a need to create compatibility between the canal flow and the crop water requirements as and when needed during the various stages of crop growth. This will greatly increase crop yield per acre. In case of non-availability of the required amount of water to crops at the critical time of need, the yield reduces by 80% due to wilting. Moreover; silting of canals prove that they are not maintaining regime flow condition for which these were originally designed. The earthen canal irrigation system wastes 52 maf of water in seepage out of 105 maf diverted into it. The canal irrigation system therefore needs improvement to avoid wastage.

WARABANDI – A WRONG PRACTICE AS IT DOES NOT MEET CROP WATER NEEDS.

Moreover, the "Warabandi System" fixed under the Canal and Drainage Act 1887, to supply water on the basis of area to be irrigated and not on the type of crops grown is

very unrealistic and is a wrong practice. Water supply on this unrealistic basis badly affects crop yield per acre. For greater crop yield per acre, it is absolutely essential to supply water as per the physiological needs of crops. The crop water requirements during the various stages of crop growth changes, it therefore requires discharges to fluctuate in that order. This needs improvement of the canal irrigation system with fixed design discharge, restricted intensity of irrigation and cropping pattern and the supply of water as per Warabandi system on area basis needs change. The canal system improvement to supply water as per crop needs by proper regulation.

LAND CONSOLIDATION AND REPLACEMENT OF WATER COURSES BY PIPE SUPPLY

The inefficient and unlined canal irrigation system and its traditional one million miles of watercourses waste about 52 maf of water as seepage losses. The wasteful irrigation and agricultural methods and practices have to be improved to avoid huge losses and make more water available for crops besides reducing drainage effluent. Therefore, the one million miles of watercourses need replacement by "Pipe Supply". It is therefore essential to carry out Land Reform, Land Consolidation and ICWM, as all these are the various phases of improvement program. These improvements are unavoidable and will have to be implemented to avoid famine as well as to earn billions of dollars each year by exporting agricultural production. God has gifted Pakistan with huge land and water resources for agricultural development and gave the largest canal irrigation system in the world, therefore by proper and correct planning it can achieve prosperity. Holland is exporting flowers worth 4 to 5 billion dollars annually.

PROPOSED CANAL LINING TO STOP SEEPAGE

Lining of Lacey's canals as planned by Punjab would help in stopping seepage water to a great extent but the canals would silt up as usual. As a matter of fact, lined canals should not silt up. Therefore, the canals should be designed to have silt-carrying velocity to transport silt to the field, which serves as a fertilizer. This will also end the annual silt clearance ritual every year, which in fact is due to design deficiency.

As canal irrigation system has to supply assured and timely water as and when needed for crops therefore it is not possible to do so without the support of shortage. Therefore, the constructions of storage are vital and are the integral part of ICWM as well as of the Water Accord.

THE NEED FOR STORAGE WITH BETTER CAPACITY- INFLOW RATIO TO HAVE LONG LIFE AND SERVICE VALUE

Tarbela and Mangla reservoirs have already lost about 6 maf of their gross storage capacity. Tarbela's short life span and rapid silting was already estimated and known

before its construction on the basis of its poor capacity-inflow ratio. Moreover, lack of proper watershed management in the catchment area further aggravated silting. The capacity-inflow ratio is an extremely vital factor while selecting the dam site and planning long life storage to have best service value, which is essentially required for sustainable irrigated agriculture. Tarbela's active life was estimated on the basis of silt flow that was between 45 to 50 years in depleting order. This life span cannot sustain agriculture for long and has therefore poor service value. Its storage lost needs replacement by another storage.

In spite of the loss of 6 maf of the storage capacity, the second dam on the Indus has not been constructed after 1974, by the concerned authorities. This is extremely serious and the cause of great concern and a set back for agricultural production. Due to abnormal delay of about 25 years, at least 3 new storage dams are now required each with a live storage capacity of about 6 maf to support agriculture. Storage is a component of ICWM and forms the essence of IRSA Act preamble, and the Water Accord. Moreover, storage are essential for the proper regulation and monitoring of water supplies to feed canal irrigation system according to crop water needs and to bring new areas under irrigation. The IRSA Act, in its preamble therefore lays great emphasis on regulation and monitoring the distribution of water resources of Indus River in accordance with the Water Accord. The Water Accord paras 2, 4, 6, 12, and 14 (e) need storage for their implementation. Moreover, para 6 provides for planned future agricultural development that means to provide long life storage for sustainable agriculture.

THE WATER ACCORD IMPLEMENTATION NEEDS 30 MAF OF STORAGE

The preamble of IRSA Act and the Water Accord paras 2, 4, 6, 12, and 14 (e) of Part-I collectively mean to implement ICWM. The para-V of Part-II of the Water Accord requires formulating new schemes in Agriculture/Irrigation sector both for implementation over the next 2 years and during the 8th Five Year Plan Period. Moreover, the IRSA Act preamble provides to regulate and monitor the water resources development, which includes salinity and water logging besides other problems as discussed above. The Water Accord para 2, 4, 6, 12, and 14 (e) provide for storage wherever feasible for planned future agricultural development.

The para 14 (e) of the Water Accord provides to avoid all wastage. This means all flows going waste to be stored under the provision of the Water Accord. This includes wastage due to seepage from canal irrigation system and wastage due to floods.

In spite of the above provisions and the need for storage and new irrigation/agriculture schemes the policy and decision-makers have done nothing in 9 years. All Provincial and Federal administrators miserably failed to strengthen the project planning units as required in part-II, para-V of the Water Accord and did not initiate the desk studies to implement the Water Accord. The country is already with partial famine (20%) yet no steps are taken to develop water resources.

As already stated, para 2 of the Water Accord needs storage of 12.35 maf. Para 12 requirements for leaching of salts are about 5 maf. Storage already lost in Tarbela and Mangla reservoirs need replacement of about 6 maf. Storage to be lost in the next about 15 years is also estimated as 6 maf. Therefore, total storage needed as per Water Accord is (12.35 + 5 + 6 + 6) say = 30 maf. The average annual escapades to sea during the flood are about 35maf. These requirements were intimated to the Ministry of Water and Power by IRSA time and again but there is no response.

The provisions to irrigate new areas in the four Provinces are included in the above storage as part of ICWM. In reality, the Provinces and the Ministry of Water and Power have rendered Water Accord ineffective, as they took no steps to implement it. Therefore, water dispute would once again be revived outside the IRSA. IRSA worked hard to produce 30 reports in the context of Water Accord in book from on water resources development and were sent to all concerned for action but there was no reaction from the Provinces and the Federal Government.

STORAGE DAM AT KATZARA

Pakistan is handicapped in good storage sites due to poor capacity-inflow ratio that rapidly loses storage capacity due to silting and gives short life span with poor service value Tarbela dam is a living example. For storage of about 30 maf, it requires at least 6 to 7 large dams, which are not available. But very fortunately, God has also gifted Pakistan with a huge and excellent, single storage dam site having a storage capacity of 35 maf, the largest in the world at Katzara. The dam site at Katzara is nearly 10 kilometer on the down stream of Skardu on the Indus. Therefore a single storage dam is seven times as larger than Mangla dam. Katzara dam site has the best C.I ratio on the Indus with almost indefinite life span due to negligible silt flow. This dam would give excellent service value, which is essentially needed for sustainable irrigated agriculture. Katzara dam would be a multi-purpose carry over storage dam. It will generate more than 10,000 MW of hydropower and almost fully control floods. After the construction of Katzara dam, the river Indus could be channeled and used as waterway. Moreover, a lot of riverain areas could be reclaimed for agricultural activity. If this single storage were constructed, it would be possible to bring vast areas under new irrigation in the four Provinces, most by gravity flow. "Fateh barrage" is proposed to divert water for this purpose on the downstream of Chashma Barrage on the Indus from where channels will take off both sides of the barrage to irrigate lands in the four Provinces. Therefore, a combination of Katzara dam with Fateh barrage would serve as the spinal cord of sustainable irrigated agriculture in the Indus basin serving all the four Provinces. In spite of these conditions, no notice is taken of the Katzara dam site near Skardu by WAPDA.

KATZARA DAM ONLY SOLUTION TO IRRIGATE GIGANTIC KACHI PLAIN IN BALUCHISTAN AND LIKE AREAS IN OTHER PROVINCES

In view of para 4 and 6 of the Water Accord, the proposed storage would release water and would be diverted from the proposed Fateh barrage located down stream of Chashma barrage on the Indus in Dera Ismail Khan for future planned agricultural development. The gigantic kachi plain in Baluchistan would mostly be irrigated by gravity flow. It would irrigate Upper Sindh and also supply water to Thar Desert. Similarly, Thall and Cholistan deserts in Punjab can get irrigation supplies in addition to other areas. Moreover, NWFP can also make use of it by lifting water for the plain of Dera Ismail Khan. Punjab can also irrigate these vast areas in the four provinces except the "Katzara storage dam" in combination with "Fateh Barrage". The future of Pakistan's progress and prosperity lie in this combined scheme in the context of ICWM and in the implementation of the Water Accord. The hydropower generation from Katzara dam can be used in lifting water in any of the four Provinces where needed. During the British period, almost all gravity flows irrigation schemes wherever possible were constructed. Now there is hardly any area left that can be irrigated by gravity flow. Therefore, higher lands shall be brought under irrigation by lifting water. The use of sprinkler irrigation method should be adopted as far as possible. If Katzara hydropower is made available, then sprinkler irrigation system can be practiced on a very large scale in the Indus basin. This method of irrigation uses about 30 to 40 percent of water used by flooding. A lot of water can therefore by save which can be used for the irrigation of higher lands by lifting it. Afforestation and orchards can be raised by drip irrigation system, which consumes negligible amount of water.

New irrigation and storage schemes may be initiated by preventing and using waste flows as provided in part-I and II of the Water Accord.

WATER DEVELOPMENT TO ENSURE FOOD...A CONSTITUTIONAL OBLIGATION

The constitution of Pakistan provides to develop the natural resources of land and water for meeting the basic necessity of life such as food in article 38 (d) read with articles 29, 155, and 156 of the Constitution through the National Economic Council headed by the Prime Minister. The article 38 (d) specifically provides that the State shall provide the basic necessity of life such as food etc. The articles 29, 155, and 156 (a) and (b) provide to formulate plans in economic policies among which the most important is the development of water resources for irrigated agriculture on sustenance basis to produce food and being economic prosperity.

The IRSA Act and the Water Accord have therefore great supporting relevance to the provisions of the Constitution in developing water resources to improve the economic condition, which is mostly based on agriculture. The development may be taken in hand at the earliest. Besides this, the Council of Common Interest (CCI) must also take interest in developing water resources, as the Water Accord of 1991 has totally been rendered ineffective.

The inert role of the Pakistan Chamber of Engineers and of the PEC is most regrettable. The solutions to the above mentioned problems need the active attention of the Government for which the Ministry of Water and Power should have approached the President of Pakistan Chamber of Engineers under rule-II, Function, sub-sections (i), (vii) and (viii) for seeking advice. The NEC headed by the Prime Minister should take notice of the numerous problems as described and the failures of various water resources development schemes for drainage Water Management, storage and irrigated agriculture as discussed in this paper. Moreover, new irrigation, drainage and storage schemes as part of the Water Management proposed above may also be taken up for investigations in view of para-V of part-2 of the Water Accord.