Working Paper

15

Sardar Sarovar Revisited

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October 2013

Sardar Patel Institute of Economic & Social Research

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Contents

List of Tables

List of Figures

List of Abbreviation

AIBP	Accelerated Irrigation Benefit Programme
CEPT	Center for Environmental Planning and Technology
CWC	Central Warehousing Corporation
FAO	Food and Agriculture Organization
GoG	Government of Gujarat
IFPRI	International Food Policy Research Institute
IIMA	Indian Institute of Management Ahmedabad
MP	Madhya Pradesh
NCA	Narmada Control Authority
NGO	Non-Government Organisation
NPG	Narmada Planning Group
NRSA	National Remote Sensing Agency
NWDT	Narmada Water Dispute Tribunal
SAUNI	Saurashtra Narmada Avtaran Irrigation
SCADA	Supervisory Control and Data Acquisition
SIR	Special Investment Region
SSNL	Sardar Sarovar Nigam Limited
SSP	Sardar Sarovar Project
TERI	The Energy and Resources Institute
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organization

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Yoginder K.Alagh

Abstract

The Sardar Sarovar Project (SSP) itself has taken a life of its own and is showing substantial benefits although it has not been implemented the way it was designed. The benefits include the use of the entire available water, including ground water. The distribution pattern for appropriate use can be estimated with details by hydrological flow studies. It can maximise its returns by working out the crops the farmer would grow with the available water in each agro climatic regime. Its benefits can be worked out based on crop cutting experiments using the frequency of watering as an instrument. However the quantum and nature of benefits is questioned, somewhat paradoxically by some though not all the stakeholders of the project. The delay in the implementation of the SSP has led to several consequences, which are detailed in this paper. Incomplete distribution systems lead to higher losses in conveyance. This has led to so called "shortages". Inspite of this project benefits are high as measured by independent studies. The project was planned in a Framework Planning Method. Irrespective of the diverse view points it has been observed that there is a synergy in water as a resource emerging from complimentary and sustainable use with more holistic approaches and this can only be captured with more integrated methods of measurement. The paper highlights such issues.

Key Words: SSP, Water Resources, Water Deliveries, Farmers, Technocrats

This is the revised version of the paper delivered as 40th Bhaikaka Memorial Lecture organised by 'Charotar Vidya Mandal' at Vallabh Vidyanagar, Anand.

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1. Introduction

The Late Bhaikaka Patel was a great warrior for the cause of Gujarat. Sardar Sarovar Project (SSP) was a large part of his vision. So when asked to deliver this lecture it was natural for me to take up the Sardar Sarovar Project. The Sardar Sarovar Narmada Project is a much discussed project. Reviled by some critics it has also been described as a great advance in the planning of irrigation projects for Asiatic peasant agriculture. Its distribution planning techniques have been widely replicated and used for example in the Mekong Framework Plan of the Mekong Commission. These aspects have been discussed earlier (Alagh, Pathak and Buch, 1995, Alagh, Desai, Guha and Kashyap, 1995, Alagh, 1996 and Alagh, Panagre and Gujja, 2006) and I don't intend to repeat them. Now there is a fair amount of acceptance that the planning of SSP was of a high order (Guro Andahl, 2010), but there is a critique that it was a planned project by the technocrats and the human and social aspects were ignored which has been discussed further.

The project itself has taken a life of its own and is showing substantial benefits although it has not been implemented the way it was designed in the sense that the opponents were able to delay it substantially. The quantum and nature of benefits is also questioned, somewhat paradoxically by some though not all of the stakeholders of the project. However some detailed field studies available now can be used to settle these issues ((Prerna Desai Vaidya, 2011, Kumar, et. al., SSNL, 2011; also see A.Garg, et. al., 2011 for a secondary source analysis) and the critique that irrigation benefits for Gujarat's high agricultural growth are not arising from SSP but other sources of growth are now muted (See Jagadeeshan, 2011, for this refutation). It would be incorrect to deny additions to the special financing mechanisms for this gigantic project on that score.

The delay in the implementation of the project has also led to another consequence. The project was planned in a Framework Planning Method. It was basically planned to use all the available water, including ground water, by estimating some details regarding distribution pattern with the help of hydrological flow studies. It maximises its returns by working out the crops the farmer would grow with the available water in each agro climatic regime and

work out its benefits based on crop cutting experiments using the quantum of watering as an instrument. The only social aspect it considered was a shadow wage rate of 1.25. In other words a rupee of wages could be counted as a benefit of a rupee and a quarter while evaluating the design of the delivery of water.

Meanwhile as time passes; memories of the original plan dim and a number of exciting new alternatives are visualised. In a water scarce area the number of such possibilities are very large. Given the passage of time redesigning the plan is of some importance. New crops are possible. Scarcities change. Gujarat and Indian agriculture is now trade dominated. So the ambition is that "the role of Narmada water is going to be larger than planned"(Jagadeeshan, 2011, p.913). Resource based planning is important to keep us anchored on the ground. A more serious reason for this caution is the fact that central resources have been an important part of financing the project. Resource based planning is the only way of accessing them. The conditions of central assistance for the project are stated as set up twenty five years ago when it was approved by the then Prime Minister. He was convinced of its merits and became a great supporter of the project, in spite of its many critics. These may need review but in doing so we have to show the same rigour as SSP planning always has shown. This is the only way to get our way again otherwise the project can get lost. The details can be discussed now.

2. Project Characteristics & Brief Technical Details:

Project Characteristics are not always remembered. A recent authoritative review sums up the special planning characteristics of the SSP as follows;

"Some of the unique features built into the planning of the project are concrete-lined canals to reduce conveyance losses, use of control volume concept for design of distribution systems, efficient water use allocation with optimised crop planning for 13 different agro-climatic zones of the command, extensive irrigation to a 180,000 ha area with just 21 "delta supported by the use of 8" of groundwater , deepening of village tanks for borrowing soils for canal embankments, computerised automated operation of canal system, participatory irrigation management through Wager Users Associations, and promoting micro-irrigation systems like drip and sprinkler for efficient water use.' (Jagdeeshan, 2012)

2.1 Water Resources

There is a synergy in water as a resource emerging from complimentary and sustainable use with more holistic approaches and this can only be captured with integrated methods of measurement. An example is surface and ground water resources. Precise assessments can in many cases make the difference between scarcity and conflict, on the one hand, and the possibilities of a judicious management strategy on the other. Water is both surface and ground. These concepts have been described well by geographers and a classic description is done by the Russian academician Dr. Galina Sadasyuk (See Alagh, 1991 for a detailed discussion). Sadasyuk and Sengupta, (1968) for example, divided India into 18 agro-climatic zones and 44 sub-regions (See Alagh, 1988). Similar exercises have been developed in other large countries, for example, Brazil, Indonesia and even France (See Ignacy Sachs, 1991, Lutfi Nasution, 1993).

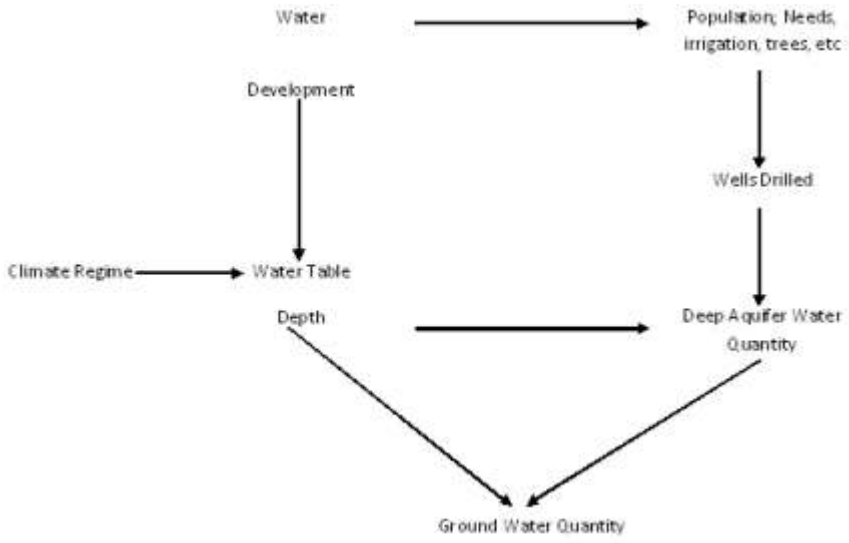
It is at the agro-climatic subzonal level that resource availability of water can be given teeth to. This is not to say that the existing estimates of a more global kind are of no use. In many cases they are all we have, but the quest for improvement is not only that of conceptual and numerical precision, but that of an improved understanding of the processes through which renewable supplies of water are generated and without that, numbers of x cumet/per caput will remain not only an abstraction, but also subject to a degree of avoidable variability. A parallel in Economics was that the measurement work of Wassily Leontief and Richard Stone was closely intertwined with the conceptual development of modern quantitative macroeconomics.

While not strictly so, water can be treated as a renewable resource. Fresh water supply can be determined in an agro-climatic regime in a defined time period (Alagh, 1991, 1998). For a political entity like a country or smaller administrative boundaries, a rough water availability indicator can be estimated by dividing the renewable water supply in a time period by the population of the country or region, in the same time period. The available renewable water supply includes (a) internally produced surface water, (b) internally produced ground water and (c) river flows from the adjoining countries/spaces of the region. The Falkenmark Index

is based on a yearly time period and consists of 1000 persons per 1 million cumet or one flow unit. 1000 cumet/percaput annual therefore becomes the dividing line for water scarcity (Falkenmark, et.al., 1989). Water flows do not follow administrative or political boundaries. Aquifiers are confined by geo-physical and not by political and administrative features. Climate also determines the demand for water, including evaporative demand. Seasonal rainfall cycles can be very different across countries. For structural understanding and policy analysis, general indices have to be used with care.

Water availability, in fact is now also estimated as a part of structural analysis and advanced project level design for both aquifier management and drainage and conjunctive use projects, with a reasonable degree of accuracy. For example, the Mike She Model of the Australian Murray Darling Basin Plan models is used by the New South Wales Department of Land and Water Conservation. While it is used for integrated catchment modelling, for the basin, it's main features "are that it can represent all major flow features in an area and is well suited to describe the dynamic interaction between the surface and subsurface water systems". The flow chart of a simple multi level model can be as follows:

Diagram-1: Water Resources:



Source: Nicholas Sonntag (1996)

A detailed version available, which gives additional resources of water made available by a precise basin level assessment, has been reported in a set of studies compiled by William Fisher (1995). For the Mahi Narmada Doab, a model developed by Alagh and Buch gives initial heads in 1980, calibrates heads for 1990 and forecasts for 2000 under alternative use assumptions. The model shows sensitivity of outcomes to trees planted, irrigated surface and pumps drilled (W.Fisher, Columbia Seminar Series, 1995, pp.291-318).

Interesting work includes sensitivity of estimated resource flows of water available with integration of surface flows with local small storage projects. Alagh (2002) has reported an augmentation to the extent of 14 % of estimated water availability as follows:

Table No.1: Tank Storage in Shedhi System

Year	No. of Tanks Deepened (progressive)	New Capacity Creation MCM	Range of Deepening (m)
Season 1993/94	150	3.5 (6.0 to 9.9)	1 to 6
By June 1994	254	6.0 (7.9 to 13.9)	0.25 to 9.3

Source: Y.K. Alagh, 2002

Fourteen percent additional water cannot be considered trivial in a water short context. It is interesting that the Shedhi Branch of the Mahi system was planned on the basis that there are no tanks in the system. The point of these micro studies and approaches to assessment of available water resources is to emphasize that the quantities themselves are sensitive to detailed resource inventorying as compared to initial assessments based on empirical formulas, projections of a preliminary kind and in some cases 'guesswork'. There is a synergy in water as a resource emerging from complimentary and sustainable use with more holistic approaches and this can only be captured with more integrated methods of measurement.

The argument here is that conceptually the measurement of water availability has to be in the context of a physical system and therefore is in the ecological domain. There is an element of circularity in the reasoning of using water to define agro-climate and agro-climate to measure water. It is unavoidable in a simultaneously functioning system. In a circular chain

of causation it does not matter where you begin. But there is a more difficult problem, which is that given physical facts, there are probably no unique ways of determining physical systems for estimating water flows per unit time. This will involve some conceptual work on how close is "close" in agro climatic space. What is the degree of aridity or lushness which distinguishes one space from another? Statistically satisfying procedures do not give spatially coherent categories and this is an area for more work (See F. Fisher, 1965).

The argument is that of a new research effort in a State like ours at integrating water resource assessment work with agro-climatic regional categories and that of improving the precision of the estimates and setting the base for more work on the features which augment the availability of fresh water in a renewable manner. The plea here is for a fairly large research effort, based on the work done for the SSP which corresponding to agro-climatic concepts defined in a regional context, simultaneously models water availability. Surface-groundwater interaction models are by now common. It is being suggested that such modeling should be attempted more systematically, not in response to project formulation work, but with instruments of a water conserving or water augmentation nature built in. In a three to five year framework, it should be possible to generate knowledge, from which generalization could begin.

Groundwater mathematical modeling techniques and surface water transport models provide powerful instruments for planning, operating and managing complex ground water systems. Some of these techniques have been used for the command area aquifers. The models if adequately framed and validated can provide useful insights on the following:

a. Broad quantities of usable groundwater that could be integrated with surface water for conjunctive use.

b. Areas vulnerable to water-logging with their locations.

c. Resultant water quality parameters after canal irrigation and assessments on their configurations.

The models can be recalibrated/updated as and when required to be eventually used for

monitoring and management of ground water systems. Such studies were done for Sardar Sarovar. Mathematical models have been developed using the services of Indian consulting firms for the command area at different time stages as under and these together represent about 71 per cent of the command:

a. Narmada-Mahi doab 6430 sq.km

b. Shedhi-Sabarmati doab 1660 sq.km

c. Sabarmati-Banas doab 11610 sq.km

d. Banas to Rajasthan border 4630 sq.km

Important features of the four models are summarized below

Table No.2: Areas Covered

Doab and model	Typical scenarios	Percentage of gross model area likely to be waterlogged
1. Narmada-Mahi model (representing GCA OF 7900 sq.km)	(a) Surface irrigation at 1,000 mm per ha and no conjunctive use. (b) Surface irrigation at 700 mm per ha and conjunctive use of 350 MCM	Hazardous and ruled out. 10 (6 to 8 per cent in GCA)
2. Shedhi-Sabarmati Model, (representing GCA of 2,925 sq.km)	Conjunctive use of same order with accelerated pumping in 4 vulnerable talukas	2 (1 to 1.5 percent in GCA)
3. Sabarmati-Banas model, (representing GCA of 11,033 sq.km)	Surface irrigation of 515 mm per ha; ground water use of 195 mm per ha of GCA	20 (largely in Class-6 soils along the strip parallel to Rann of Kachchh, 10 to 12 percent in GCA)
4. Banas-Rajasthan Border model (representing GCA of 4,630 sq.km)	Surface irrigation of 515 mm per ha and limited conjunctive use (corresponding to normal growth of 1998 level)	17 (largely in Class-6 soils along the strip parallel to Rann of Kachchh, 8 to 10 percent in GCA)"

(Source: Y.K.Alagh, M.Pathak and D.T.Buch, 1995, pp.110-111,118)

It cannot be ruled out that assessments of water as a resource can gain a larger dimension if the resource assessment exercise is done. Until then it would be prudent to use the available estimates of available water as the resource limit for policy making. According to Ahmedabad based newspapers of 3rd Jan. 2013, SSNL has wisely clarified that the demand of the Dholera SIR (Special Investment Region) that Project Narmada waters must be made available to it from the agricultural command of the SSP Boucharaji area will not be accepted and water for the MARUTI project at SIR has to be met from the sanctioned supply of 1.2 maf for industrial and urban needs.

3. From Water Resources to Water Deliveries:

Let us begin at the level of the agricultural field. Irrigation engineers have to learn to design water delivery systems differentially for the different regions of a canal-command. For too long, commands of large irrigation projects have been treated as homogenous and uniform entities. Soil conditions, temperature and its distribution, rainfall and its distribution, the ground water regime, existing forest cover and existing tanks and minor rivers and drains are all features which need to be paid very detailed attention. This will normally require that a command is regionalized into components. The initial intention in SSP was to provide for a uniform pattern of irrigation through the command. After detailed consultations with geologists, demographers and land use planners, meteorologists and agricultural scientists, the command was broken up into 13 regions (See, GoG 1989 and Y.K.Alagh,1991, pp.160-162). This phase is important for irrigation planning. This phase has to be seen not just as a question of regional studies. The association of the irrigation engineer with the wider disciplines and demands of agriculture, of geography and land use, meteorology and ground water will from the beginning sensitize the irrigation planner to the diverse agro-climatic and agro-ecological environment in which the water system has to operate and this sensitivity is extremely important to planning the physical features of the irrigation structures.

There is the much vexed question of cropping patterns and the problems that arise when the 'design' cropping pattern does not materialize on the field or the 'sanction' for the crop(s) is violated in practice. The practice was to consult agronomists and to fix these parameters into

the design of the project canal capacities. The outcomes depended on the seriousness of the agronomist who gives the projection. In one particular case of a project which used to be singled out by Prime Minister Indira Gandhi for critical comment, (Tawa), the cropping pattern in the project area was taken from the Second Five-Year Plan of the particular State in which it was located. The project area was less than 5 per cent of this large paddy growing State. Paddy was totally unsuitable as a crop for the black soil in the command area. But somehow paddy was recommended as a crop for this project. Irrigation systems designed for paddy of course created considerable havoc in the subsequent phases of development there.

3.1 Farmers driving Engineers

SSP distribution design was done on the basis that there is considerable need to understand and quantify the behaviour of the Gujarati farmer in the agro-climatic regime being studied. Economists have for long worked on this problem and have developed 'acreage response models.' These essentially postulate that the acreage allocation of the farmer follows profit maximizing behaviour and depends on rainfall and its distribution, irrigation, the agricultural technology available and relative prices, which capture the economic environment. The use of these models for irrigation planning would mean that the farmer's behaviour is studied and statistically estimated for an area of the kind being supplied water with due consideration of the agro-climatic characteristics of the region in the command. Such studies are done with the farmers in groups. This was done for preparing the SSP Plan and is being done now again in Dabhoi in SSP in Gujarat where farmers irrigation groups have been created.

The initial work estimated alternative crop sets that the farmer would consider once irrigation is available to him. These models were of an econometric variety. Potential crops for the command were worked out with agronomic studies. For each possible crop set in each region, using potential crop yield and cost of cultivation data for each crop, value added in agriculture was worked out. Given - the estimates of costs of delivering water, value added was maximized for all regions applying a social wage criterion assuming that a rupee of wages was worth one hundred and twenty five paise to society. The important issues,

therefore, were to use farmer's behaviour patterns to work out cropping possibilities; to allocate water subject to ecological constraints (water-logging and drainage parameters); and to explore in details the benefits arising from spreading water through the command rather than concentrating in a few areas to avoid the tail ender problem.

Technological aspects like distribution systems with sufficient capacity, control (for regulation) and efficiency (to avoid losses) were as important as the use of appropriate economic mechanisms, e.g., pricing of water and incentives for groundwater use. An estimate of possible crop sets for one region of an irrigation command in which this method has been applied is given in Annex 1. The method essentially reduces the theoretical cropping sets from infinite possibilities to a set of alternatives which need to be considered for irrigation design purposes. It also sensitizes the water resources engineer to the possibilities of alternative agricultural development in the area in which he is working.

The peak requirement would determine the engineering design parameters for construction. This was done by further work. For each possible crop set in each region, using potential crop yield, according to crop cutting experiments which give actual yields on farmers fields, were tabulated by the Agro Economic Research Center at Vallabh Vidyanagar, because it had data on yields by the number of waterings, and cost of cultivation data for each crop, value added in agriculture was worked out. Given the estimates of costs of delivering water, it was possible to work out value added for all regions applying a social wage criterion which was derived after examining inter-regional irrigation possibilities. The important issues, therefore, even now, are to use farmer's behavior patterns to work out cropping possibilities; to allocate water subject to ecological constraints (water-logging and drainage parameters); and to explore in details the benefits arising from spreading water through the command rather than concentrating in a few areas to avoid the tail ender problem. Technological aspects like distribution systems with sufficient capacity, control (for regulation) and efficiency (to avoid losses) are as important as the use of appropriate economic mechanisms, e.g., pricing of water and incentives for groundwater use.

At the risk of repetition we would like to reiterate that once cropping possibilities are known

the problem is to fix the water to be delivered to each region. Now if information on alternative crop sets of the kind discussed earlier is available and the yield from irrigation can be estimated with the degree of precision indicated for a recent period and the costs of building conveyance systems to the field can be estimated accurately, a very precise estimate of the benefit of irrigation can be derived. Such calculations, already made for SSP (Annex 2) are not written in stone but if new ideas are there these must be justified in a quantitative manner With these kinds of calculations, if an explicit weight has to be given to generate more employment in some poverty stricken region, this can again be done in a quantifiable manner. If scarce water is redistributed in an arbitrary manner, as some may want, for example the Dholera SIR demand and others, there have to be non arbitrary procedures to evaluate them if unfortunate consequences are to be avoided later.

Another feature can be noted, namely that systematic monitoring of ground water and the construction of water balance models at the level of an aquifer are in fact not very expensive propositions today given Google Earth and can be followed through fairly easily with modern computers, once the basic information is available. Given preliminary estimates which can generally be built with easily available bore hole data, soil characteristics and land use information, more refined models can be developed as the investigation of soil characteristics and the ground water regime proceeds at micro levels. As an example the present author can refer to a TERI project he had chaired to evaluate the consequences of Coca Cola operations in India (TERI, 2008).

These kind of issues are now gaining urgency. All the canal regulating structures of SSP with discharge of more than 8.5 cumecs are to be operated automatically with a view to ensure safe, flexible and efficient operation. The pilot Project of Canal Automation, a SCADA based Remote Monitoring and Control System , has been revived and its scope has been extended to include the entire Narmada Main Canal beside the Vadodara and Skarda branch canals (Jagadeesan,2012,p.212). This was attempted earlier in 2005 and apparently given up then, since a paper by A. B. Mandevia gave a counterfactual of how such a system designed for SSP was being implemented. Pre-qualification of bidders for the Sardar Sarovar Canal Automation Project was advertised in 2005. This was for a Remote Monitoring and Control

System for Canal Network (Canal Automation) interfacing with Supervisory Control and Data Aquisation (SCADA) System for the Pilot Project consisting of Narmada Main Canal Reach Km. 0.0 to 105.344, Vadodara Branch Canal (with Jambusar and Kundhela Branch Canals) and Sakarda Branch Canal Systems. Again the newspapers in mid-2013 carry the advertisement of tenders being called by SSNL for the SCADA project.

There is some urgency to getting back to the original design configuration of the SSP plan. As long as upstream use of Narmada waters was not according to MPs full entitlements, we as the lower riverine State were entitled to all the water flowing down from the Sardar Sarovar Dam. This was more than the water which would be available as our share when M.P. uses all its share.

The SSP plan had anticipated all this. Therefore in its 3 Reservoir Model of hydrological flows when Narmada Sagar as it was called then and Indira Sagar now was ready but upstream water use was little, in Stage I, 15.81 maf of water was available at 75% reliability.(SSP,NPG, Planning for Prosperity,1989, p.218). But with further development upstream in Stage 2, we would get close to 9.5 maf, which is our entitlement in the NWDT award. This year for example, as the flows dwindled, the police had to be called in to stop withdrawal from the canal systems. The computer controlled systems planned for SSP in 1985 are needed to maximize timely deliveries with scarce water. That situation is emerging as MP uses more and more of its share after Chattisgarh has been separated and its water and hydel energy sources depleted in relation to needs of fast growth. To me it is these needs which dictate the urgency in getting back to SCADA in official priorities in the SSP project and I for one welcome it. Better late than never.

A recent study in a volume published by the SSNL/CEPT says: “Another dimension is the current sumptuous water availability in the three districts studied owing to curtailed command area coverage at this point in time as compared to the full command area of the proposed canal irrigation system. These three districts are getting more water than what they would get once the command system is completely developed and made fully operational. This relative future paucity of water could create social stresses in the affected districts”

(A.Garg, et.al., 2012, p.663).

Two decades ago I was asked why I want the SSP dam to go to its full height, when after it reaches the stage when water is diverted into the SSP canal, the biggest irrigation canal in the world, Gujarat would get the entire river, my answer was that I am a Gujarati and an Indian. I want the poor and developing State of MP also to get its share. Also as people we understand the pain of being deprived of our legitimate share by misguided opponents (Alagh, 1996, pp.266-267).

4.Outcomes:

There are two issues here. The first is that I believe, contrary to critics of SSP that even its partial completeness, is a large factor in Gujarat's fast agricultural growth. The second is that in areas where water is being delivered, field studies show that change is substantial.

4.1 SSP and Gujarat's Fast Agricultural Growth

In the last decade Gujarat's agriculture has grown fast. This growth was not there in earlier decades. To say that it is 8 to 10% annual is incorrect. I was a part of the FAO's team for their global model then called Agriculture 2000 (now Agriculture 2030). A 4% plus annual growth in agriculture is seldom seen in world history and even if we did not achieve 10% our growth is respectable.

Growth in a dry land agriculture and our irrigation coverage is still low, fluctuates and two statistical sins are unforgivable. One is to take bad initial and good terminal years. Also never calculate growth in current prices since that values inflation. If a three year average is taken of the GDP from agriculture at 2004/05 prices as currently reported in Gujarat's Socio Economic Review, then the figure could be as follows.

Table No.3 Agricultural Growth Rate in constant 2004/05 prices;2004/05 to 2009/10

Period	Growth Rate (% compound annual)
(Triennium averages of base and terminal years) 2005/06 to 2008/09	3.1

Source: Gujarat's Socio Economic Review, 2004-05 — 2009-10

This is the growth rate given in some planning documents and I believe it is an underestimate, which is not 10% & not 3%.

Shanker Acharya (article in the Business Standard) takes a few years at 1999/00 prices and others at 04/05 prices .This is done earlier by A.Gulati in an IFPRI study and now by B,Debroy. This measures inflation from 1999/00 to 04/05 and so this estimate of 10% is wrong. A different method, not absolutely precise but a reasonable guess, is to work out the difference in the 2004/05 prices between the old and the new series and use that difference to what is called splicing the series. That difference was 23.98% which Shanker Acharya had wrongly calculated as growth while it was a price difference. Correcting the earlier series by this factor and then reworking the growth rate between 2003/04 and 2008/09, again using triennium averages, we are taking data from 2002 to 2009 and working out the Results after splicing the GDP series are:

Table No. 4 Agricultural Growth Rate in constant 2004/05 prices, splicing 02/03 data:2002/03 to 2009/2010

Period	Growth Rate (% compound annual)
(Triennium averages of base and terminal years) 2003/04 to 2008/09	5.1

Source: Gujarat's Socio Economic Review, 2004-05 — 2009-10

From the period since the Sardar Sarovar Project is supplying water to Gujarat (2002) its underlying growth rate is 5.1%. This is not 10% but is still one of the highest agricultural growth rates achieved anywhere in the world for a decadal period. It is also close to the SSP target growth rate of 6% annual (See GOG, Planning for Prosperity, NPG).

It is to accelerate the implementation of the canal distribution project that I had accepted the

invitation of the Government of India to head a Committee with the ToR which read as follows:

“In its Office Memorandum of 28 April, 2010, the Ministry of Environment and Forests hereby constitutes a High Level Advisory Committee with the objectives to interact with the State Governments, civil society and other concerned stakeholders for the steps required to be taken for the implementation of the plans in a time bound manner". The ToR also recommends indicators and mechanism for long term monitoring of the implementation of action plans and undertake any other task which it feels is in furtherance of the interests of the purposes for which it is formed. However this faced opposition from activists and others and so it was put on the back burner.

It is said that agricultural growth is diversifying. To some analysts, it is sourced by globalizing markets and village talavdis, since SSP is a disaster, assumed by many and also mentioned by an American institute which has said all this. American institutes don't like canals run by the State and say only private wells and tanks matter. But actually canal area went up in this period by 108%, tube wells went by only 25% and tanks stayed put. Actually instead of diversifying we started producing more wheat and rice. We have not built our distribution systems. Canal systems which don't control water let you grow only water intensive crops. Apart from cane the other commercial crops can't grow with flooding, so diversification is pushed back. Since area under commercial crops is growing in this period at less than half that of grains, the share of acreage under commercial crops in area is not going up. This has to change instead of abusing the SSP canal systems. The area in food crops in Gujarat grew by 8.27% from 01/02 to 06/07 for which comparable figures are available and more since (08/10) but those are preliminary numbers which change. Meanwhile for the same period triennium averages show that area under non food grains crops grew only by 4.56% so the share of nonfood commercial crops went down. The only crop which held out was cotton on account of the Bt technology. In fact the wholesale price of wheat and paddy in Gujarat is the lowest in India and that is a lesson that SSP benefits will depend on simultaneous development of agricultural market towns.

Initial teething problems will need to be resolved but with regard to SSP it is quite clear that

the major source of agricultural growth for Gujarat is as originally planned and now implemented through SSP .Controlled water supply and strategies for market and price support mechanisms will again lead to larger achievements. The official statement that I fully support is as follows;

'National Remote Sensing Agency (NRSA) has estimated the area irrigated by the Narmada Canal network at 392,158 ha in Phase-I and 267,430 ha in Phase-II. According to this study, more than 660,000 ha land is being irrigated regardless of the missing links in the command area. Noted Economist and former Union Minister Y.K.Alagh, who was also instrumental in planning the project, has expressed this achievement in these words: " With more irrigation, total yield goes up. As ISRO satellites show us on January 31, 2009 area irrigated by SSP canals was 3,74,606 hectares. On 28th September, 2008 it was 2,46,995 hectares. SSP is delivering to farmers, with good and bad canals, 6.21 lakh hectares of irrigation. Of course we want thrice as much and we want it controlled, so that more people benefit, our land is not spoiled and our crops are diversified. But, Planning for Prosperity said in 1985 Gujarat's agriculture will grow by 6 per cent after it delivers. That's the way it is today" (Alagh, 2010)' (Parthasarathi and Dholakia, 2012, pp.898-899).

4.2 Field Studies:

Two recent field studies of a substantial type with large samples bring out the output enhancing effects of SSP canal waters. One is by the NGO Sneh Setu by Prerana Desai Vaidya (2011) and a later one by IRAP(2012). The former study presents results for the Narmada-Vadodara District(called region R_1P_1), Vadodara-Panchmahal District (called Region R_1P_2), Vadodara Bharuch (called region R_2), Bharuch (called Region R_4). These regions were from the original SSP regionalization. IRAP also has samples from these Districts. Both the studies also have other Districts but these are not covered by both studies and hence we are not discussing those Districts.

Annex 3 presents the comparative results for Kharif illustratively. Inspite of the fact that the Sneh Setu study was done almost five years earlier the results reinforce each other. Paddy,

Maize, Bajra and Pulses including Tuver are still important. Fodder has come up as a crop. Cotton was a favourite. The studies bring out the substantial income and employment effects and also the dependence on other sources of irrigation. Animal husbandry development is hastened. SSP makes a major contribution to drinking water. There are examples of drinking water supplies being used for irrigation (Alagh, 2012).

5. Issues on Technocrats:

Since Sardar Sarovar played such an important role in Gujarat's development in the recent phase and its evolution is a part of global debates it is useful to recapitulate some facts and opinions. Planning for Prosperity, the over 500 page highly rated SS Plan is my baby and it saw us through the vicious attacks on the project because it was transparent, fact based and built by highly motivated persons. In the Eighties Sheshan spread the idea that the late Rajiv Gandhi approved the project on account of pressures. This is incorrect. The Prime Minister was critical of the Project on account of the views of the Environment Ministry but when it was put up for approval to him by me as a member of the Planning Commission he went through it in great detail. For example he personally examined the monitoring systems set up then to track ground water levels in the Mahi Narmada Command at over a hundred points and data collected through real time. He saw that ground water would be monitored and if it rose it would be pumped back into the canal which was designed for that purpose. No water logging would take place. He also personally looked through the monitoring reports on the rehabilitation by TISS and the Surat Center and the rehabilitation plan. It was only when he was convinced he approved the project and then became one of its great supporters.

I was thirty five years young when asked to plan the project and am seventy three years young now and again have been called a technocrat. For economists in government the late seventies were heady days. Arjun Sengupta was in Commerce, Bimal Jalan in Industry and Nitin Desai and Vijay Kelkar with me in the Planning Commission. The PM was in Finance Ministry. Asked to stay on I was very clear that I must go back to my research job. Returning to Ahmedabad in 1979 the Chief Minister asked me to plan the Sardar Sarovar Project. I flatly refused telling him that I had not returned from Delhi to do another government job and that

too in the State secretariat. I suggested some names but they wouldn't bite. A World Bank mission came led by Per Jeung an engineer trained by Myrdal and the CM asked me to meet them without any commitments which I did. Jeung told me that Ahmedabad did not have any planning capabilities. I asked him and his team to join me for dinner at my home and invited friends like Vijay Vyas, then IIMA Director, the architect Doshi, the Gujarat Vidyapith sociologist Vimal Shah and the journalist Nirhu Desai. Jeung was to report back to the CM that he saw progress in planning for SSP. There was no going back for me for Narmada was at the heart of Gujarat's dreams. I accepted with a one rupee salary.

6. Our Side in the Global Debate:

We built up a great team on planning Sardar Sarovar and some of the best universities and institutions were involved. Mahesh Bhai (Prof. Mahesh Pathak) is here. The rest is history. The project got caught in the cleft hook of an activist tirade built up largely outside Gujarat and India. Those who worked on it in civil society and academia hit back even though living in an exchange controlled economy they did not have the resources to fight on a global plane. Anyway the project progressed with some delay and gradually a counter literature was established on the critiques. The turning point was a scholarly book by William Fisher at Columbia (1995) whose sympathies were with the activists but was too good a scholar to ignore the opposite point of view. His collection of alternative angles was widely read. Now a Norwegian scholar has worked on the subject spending quite some time in Gujarat and elsewhere (Aandahl, 2009, 2011). Her first papers are out and again her sympathies are with the activists but she is much too honest and hard working a scholar to ignore alternative view points. She is extremely critical of the SSP planners, particularly Y. K. Alagh, but documents at considerable length the work done on SSP and clearly takes the position that it is of high quality.

Guro Aandahl starts by describing the processes of the setting up of the Narmada Planning Group as an autonomous think tank.(G.Anadahl, 2009, p.7) and ' the use of the expertise of numerous research institutes within and outside Gujarat and India, and commissioned a range of studies investigating the physical and social aspects of the command area, as well as

environmental and resettlement concerns.'(Ibid., p.8). Here she is repeating what others have said. For example, In February 1985, the Staff Appraisal Report of the World Bank noted: "….within a period of three years an impressive array of high quality studies and designs have resulted, including a comprehensive frame work plan by the NPG and production by the ID (Irrigation Department) of high quality designs, specification, and procurement documents. "World Bank also felt that SSP" ….represents a break up with past approaches to the planning, design, construction and operation of irrigation projects in India."(Y.K.Alagh, 1996, p.214). She describes in detail the strategy of spreading the irrigation water and the extensive use of studies to introduce efficiency in distribution of water and avoiding water-logging.(Ibid., pp.12-13). She then describes the work to use socio economic studies and econometrics to design canal capacities and farmer managed irrigation systems (Ibid. p.14).

But to her Alagh's work is technocratic. She quotes me fairly, particularly the idea that since water does not flow up a ridge I discovered the limits of egality in irrigation projects.(Ibid., p.23). She extensively quotes Partha Chatterji to place the SSP work in a technocratic tradition. She has many references in describing technocracy to Sukhomoy Chakravarti without realizing that he was my boss and in fact doesn't relate with an earlier description of technocracy in India's Fifth Plan, by Francine Frankel (1978 & 2005), another story (Y. K. Alagh, 2010).

7. Revive Dialogues but not of the Deaf:

This is completely unacceptable. The description of migration studies on irrigation based growth as 'bullock demographics' and the use of shadow wage rates for engineering and capacity design as technocracy betrays a complete lack of the integration of economics and asset structures with social reality. If unemployment and poverty data are used to build canals, the reasons it is called technocracy is befuddling. In other words social reality cannot be analysed in terms of functioning systems for that is the level at which physical structures interact with man in society. Debate here is simply not possible unless one gets back to the primitives in terms of concepts, in other words the meaning of those words which give

meaning to a discourse. The more economics is related with social reality the more it becomes to some technocracy. We are genuinely in the realm of a dialogue of the deaf.

But we are on the top of this debate because we were transparent at the intellectual plane. Somehow we are missing out the spirit then of an Uma Shanker Joshi, S.V.Desai, Yashwant Shukla and others. We must side step the philistines. Guro Aandhal is fond of my senior, philosopher and friend, Sanat Mehta and we both hope for the success of SSP.

As I write this the Prime Minister has said that energy and agricultural technology is the butt of criticism by NGOs funded outside India. This is well known and the French policy group Herodote which works out of the President's office in France has documented how aid agencies fund global NGOs who in turn fund the critics of hydel and nuclear energy power in India (Jean-Luc Racine, 2006). Guro Andhal is not one of those but many critics don't have her integrity.

7.1 Revisioning SSP:

As I have argued the SSP plan is not caste in stone. Over decades an economy develops and changes. Technology gives many new possibilities. Planning is meant to be a flexible business in its best variants. However in some of the great social decisions, pursuit of objectives with tenacity is also a virtue not to be scoffed at. It is quite obvious that completion of the SSP plan is of great priority. As a Planning Minister of India we had approved the largest allocations from the AIBP when it was started to SSP and I believe that was justified. More recently it has been worked out that implementation of the existing plan will need allocation of over two thousand crores of rupees from the AIBP and in current prices that is not more than the allocations we got in the mid nineties of the last century when the AIBP was started by me as Planning Minister. These are justified needs and with them we will complete the project. There has been substantial development in recent years in the Project Implementation Strategy.

I also believe this is the time to strengthen its planning machinery. The available water from spills in the Sardar Sarovar Dam as estimated by the Four Reservoir Hydrological Model in

the original plan is as follows;

Table No.5 Overall Water Availability for Augmented Use

(with POWER CAPACITY 1200 MW (MAF)

Stage	Extra water due to spills
II	0.38
III	0.27

Source: Planning for Prosperity, Table 12.4, 1989

Reliable water supplies of the SAUNI project are in fact very little. Also M.P., while ruled by a BJP Government has strongly objected to the SAUNI project with the NCA and CWC as violating the NWDT award.

This may change as more detailed work is done. We must of course use these spills. Until then it will be prudent to aim as Arjuna did on the eye of the fish on completing SSP as we know it. Again one of the projects which has been projectised is putting up small hydel power generating plants on each of the regulators of the SSP Main Canal which will give us 40 MWs of power. That's not a lot but it will come almost free and prove that we Gujaratis never neglect small profits. Also there is no interstate controversy to it.

8. The Main Story

The main story as I see it is to strengthen in a big way the planning of the completion of SSP and to bring to bear on it the latest project implementation techniques. I believe there is progress in this direction in the last few years. All our energies and resources must go for this objective. The earlier hydrological and ground water models need to be reworked. While not highly likely it is possible that a more favourable resource assessment emerges. Also the Socio economic benchmark studies done for each taluka need to be redone and benefits of the project tracked in a more systematic way rather than the few studies we have. All this will not cost much as the technology has improved a lot with Google Earth and other tools. This will help us in better implementation of the project.

The computerisation of the operation of the Main Canal and the Branches and Distributaries is of the highest importance as water becomes scarcer with the upstream States using their shares. This will improve the delivery efficiency of the system. Conventional water delivery systems have a delivery efficiency of about forty per cent. In other words the water released at head works around forty percent reaches the root of the soil. Model studies show that the SCADA systems will improve these delivery efficiencies by around fifty per cent. That is a lot of water. This is the time to plan and build the agro based and urban and communication infrastructure in and around the project. The SSNL districts have a large number of what are called Census towns. In other words towns which are not even officially recognised as urban bodies are bereft of infrastructure. This will eat into the benefits of the project and we need to learn from the experience of what was called the planning of canal colonies. With imaginative policy making these would become agro based hubs of large growth. Our higher education system should also gear up to meet the great skills needed for this phase. A lot has been done. But a lot needs to be done. Economists believe that bygones are bygones. I am also a somewhat optimistic kind of person. I believe that with efforts of people like you and our leaders what needs to be done should be done.

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Annex 1
Crop Choices

Projected Irrigated Crop Sets (Fraction of Cropped Area) for Region - 1

S l. No.	*Crops*	*Set 1*	*Set 2*	*Set 3*	*Set 4*	*Set 5*	*Set 6*	*Set 7*
1	Paddy	0.16	0.18	0.20	0.17	0.17	0.12	0.10
2	KJowar	0.01	0.00	0.01	0.00	0.01	0.03	0.05
3	K Bajra	0.03	0.03	0.02	0.03	0.02	0.03	0.03
4	K Groundnut	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Wheat	0.14	0.14	0.14	0.12	0.12	0.12	0.16
,6	Vegetables	0.03	002	0.02	0.04	0.04	0.04	0.02
7	R Pulses	0.04	0.04	0.03	0.03	0.03	0.03	0.03
8	S Bajra	0.04	0.03	0.02	0.03	0.03	0.04	0.02
9.	S Groundnut	0.01	0.00	0.00	0.02	0.02	0.05	0.00
10	R Jower	0.00	0.04	0.05	0.04	0.04	0.05	0.05
11	Tobacco	0.09	0.09	0.05	0.04	0.09	0.05	0.02
12	Cotton	0.31	0.35	0.38	0.34	0.33	0.42	0.40
13	Sugar Cane	0.00	0.00	0.00	0.02	0.02	0.00.	0.00
14	Perennials & Fruit	0.02	0.02	0.02	0.02	0.03	0.02	0.02
15	Other Crop (including Lucerne)	0.06	0.60	0.05	0.05	0.05	0.05	0.05

Source: GoG, 1989

Note: K is Kharif, R is Rabi, S is Summer

Annex 2:Interregional Models

Upper limit of canal utilization ('000 Ha)	Peak canal water demand ('000 cusecs)	Peak G.W. demand ('000 cusecs)	Value of objective function (Rs. crores)	Irrigation intensity GIA CCA	Annual GW utilization ('000 hm)	Efficiency – 60%} Canal Utilisation ('000 ha) Kharif	Total	Irrigated set intensity set No/ Value	*Unirrigated set inter set No/Value*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	*(10)*
65	1.771	0.655	41.583	0.707	25.181	31.519	65.000	4/0.707	1/0.452
70	1.891	0.700	43.113	0.755	26.386	34.236	70.000	4/0.755	1/0.414
75	2.012	0.745	44.616	0.803	27.590	36.952	75.000	4/0.803	1/0.377
80	2.294	0.750	45.966	0.882	28.795	37.730	80.000	1/0.448	1/0.325
85	2.597	0.750	47.305	0.964	30.000	38.243	85.000	4/0.448 1/0.927	1/0.271
90	2.790	0.750	48.632	1.914	31.205	40.518	90.000	4/0.037 1/0.832	1/0.229
95	2.971	0.750	49.959	1.061	32.410	42.966	95.000	2/0.182 1/0.679	1/0.187
100	3.153	07.50	51.286	1.109	33.614	45.413	100.000	2/0.382 1/0.526	1/0.145
105	3.334	0.750	52.613	1.156	34.819	47.860	105.000	2/0.583 1/0.373	1/0.103
110	3.322	0.750	53.269	1.151	31.872	53.152	110.000	2/0.783 2/0.940	3/0.100
115	3.322	0.750	53.686	1.151	27.354	58.152	115.000	2/0.940	3/0.100
120	3.322	0.750	54.103	1.151	22.836	63.152	120.000	2/0.940	3/0.100
125	3.322	0.750	54.105	1.151	22.820	63.170	120.018	2/0.040	3/0.100

Source: GoG, 1989

Annex 3:Cropping Pattern after SSP: Monsoon (Kharif) Crops *						
Sr. No	Crops	R_1P_1	R_1P_2	R_2	R_4	R_5
1	Cotton/Tuver	40.8 44.8	26.3 19.9	30.7 42.9	35.3 53.3	34.1
2	Tobacco	0	32.7	0 1.3	0	15.5
3	Paddy	5.0 5.9	20.6 10.0	15.3 17.0	10.3	68.5
4	Bajra/Tuver	0	25.7 2.8 (only bajara)	0	0	0
5	Maize/Tuver	25.0 21.0	27.6 9.0 (only maize)	3.4	0	2.7
6	Pulses	30.0 9.8	0.5 7.5	35.3 3.2	37.6 34.5	9.3
7	Sesame (Til)	0	0	6.8	13.2	0.9
8	Paddy (non-irrigated)	7.5	5.3	0	1.1	0
9	Castor	3.3 0	13.9 20.0	0 7.6	0.3 6.6	4.1
10	Sugarcane	0	0	0	0 2.3	0
11	Vegetables	0	1.3	10.2	1.6	11.7
12	Sundhiya (fodder)	0	0.8	13.4	0.5	1.8
13	Jowar	0	0	9.8	25.9	0
14	Foundation crops	0	10.0	0	0	0

*The above table has multiple responses, hence the total does not add to 100
Figures in second row are from 2011 study(IRAP)
Source: P.D. Vaidya (P), 2012: D. Kumar (R), 2012
Notes :

R_1P_1 is Narmada Vadodara District

R_1P_2 is Vadodara Panchmahal District

R_2 is Vadodara Bharuch District

R_4 is Bharuch District

R_5 is Rest of Regions Covered

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