IDR : VOL. 14, NO. 2, (JULY-DECEMBER, 2016) : 193-227 | ISSN : 0972-9437|

EQUITY, EFFICIENCY AND JUSTICE IN WATER DISTRIBUTION: A CASE STUDY OF CHIKOTRA RIVER BASIN (INDIA)

Vasant Jugale[1] and Yojana Jugale[2]

ABSTRACT

Allocation and distribution of water resources is the mechanism and the criteria by which bulk water is apportioned among the different uses. The demand and supply of the water resources should get adjusted with equity principles. The supply constraints cannot be neglected or eliminated since they are the natural factors at this stage. The distribution of water per head is the next equity principles followed in the basin. Similarly, equity in water supply to different crops and plants needs to be reflected on. The non-land holders are given cultivable lands during the corresponding phases of the equity. Cultivable lands of absentee landholders are allotted to potential farmers (mainly agricultural workers) on rent basis or on the share cropping basis. The social mind is created for implementation of equity and justice in a river basin.Equitable distribution of water in Chikotra river basin is an innovative experiment in the water management system. Equity, efficiency and justice are the chief apprehension of equitable distribution of water in the Chikotra River basin.This model is being implemented in 6 villages as a Pilot Project and then to be replicated in rest other 46 villages in the valley. The villages were selected on the basis of the local support, leadership, economic feasibility, public will to participate and choice of the chief promoters. All villages are having Co-operative Watershed Management and Water Users Associations (WMWUAs) established for the equitable allocation of irrigation water among the members.The financial burden of the project is equally shared on 80:20 bases from the Govt aid and the farmers of all categories. The cost of lift irrigation schemes differs from village to village. The farmers pay their per acre share as the average cost is calculated after taking into consideration the total cost of the villages.Water conservation is planned by constructing farm ponds at the foot of the hilly area. The pond water can be used for the crops grown at the terracing slopes and plateaus of the hilly areas. As the rainfall remains high in the area, the farm ponds can be filled by rain water during the monsoon. The scarcity of water arises during the post-monsoon seasons. The Chikotra River Project is having 8 KT Weir 18 pickup Weirs constructed at the

[1] Professor of Economics, (Retired), Shivaji University, Kolhapur, India, *E-mail: vbjugale@gmail.com*

[2] Principal, Hon. Annasaheb Dange College of Atrs, Science and Commerce, Hatkanangale, Dist Kolhapur, *E-mail: yojanjugale@gmail.com*

downstream and upper run off of the river basin. More than 150 days the water flows in the river, which is now lifted by electric motor pumps for irrigating the lands in the hilly slopes of the basin, during dry spells. The water from the pickup weirs or KT weirs is lifted directly from the dam reservoirs up to the possible height. The plan of lifting vis a vis cost of elevating differs from village to village as the topography differs from place to place. The land area with varieties of soil qualities is suitable for high value crops like horticulture crops, medicinal crops and forest products.Lift and drip are the only mode of the distribution of irrigation water resources. The total land area for the distribution of water is around 2481 hectares. It means total water allotted to this land area would be around 99,24,000 cubic metres of irrigation water. Drip irrigation is obligatory for equitable water distribution. The distributive justice is provided at the village, block, valve and farmers level. Each 20 hectares or 50 acres of land area belongs to a block. The valve covers 1.60 to 4 hectares or 4 to 10 acres of land area. Each Block contains a water metre to measure the volume of water. The cropping pattern is designed as per the slopes and topography of each village. Hilly slopes compel the farmers to go for intensive cultivation techniques. Sugarcane cultivation on the hilly slopes is not possible due to lack of motorable roads. Fodder and other short duration crops are recommended for cultivation at the terraces. Cash crops like strawberry, tea plantation, high value vegetables and fruit are possible in future.

Key words: *Equitable, justice, Chikotra river, water resources, WUAs,*

INTRODUCTION

Water is one of the scarce but renewable natural resources being used by the human and other living organisms on the Earth for their survival. The water resource is available through rain and underground water recharging processes. The water-in-use for irrigation needs appropriate application of the doses depending on the crops and other natural factors like, soil, climate, rainfall and topography of the region. Unlike the other natural resources, water resources are concurrent to the national economy. Hence, its efficient management is appreciated. It is equally important to understand how alternative economic policy instruments influence water use across different economic uses/sectors and between the local, regional and national levels and among the households, farms and firms. Macro-economic and sectoral policies are not intended specifically at the water use, though they have a significant impact on resource allocation and aggregate demand in the economy; which in turn affects the water use. Therefore, the important economic attributes of water-in-use call for better analysis. Further, the type of management of water resource projects may determine the nature and extent of charges for the project outputs.

Chikotra River basin model of equitable distribution of water is an innovative experiment in water management science. It would a mile stone to other irrigation projects in India. Before going into the details of this model, which has a very wide significance, let us take a round of various aspects of water management and worldwide thinking on this precious resource.

VALUE OF WATER

Value-in-use and value-in-exchange are germane to the valuation of water resources. Value-in-use operates, when the intrinsic value of water resources is used for various purposes. Intrinsic value differs on the water qualities. Demand for water depends on the quality of the water and an urge of its application. Supply of water is limited and is based on natural atmosphere. Demand and supply of water get equilibrated with an effective domain of demand prevailing in the society and the economy. Rising demand for water is an indicator of development. Hence, a commodity does not possess economic value, if its supply is plenty. However, value-in-exchange obtains a market value or an economic value. So long as, water is available copiously, as compared to its demand, there exists no economic value to water resources. Value is a process governed by the market. Value of water depends upon the user and use to which it is set. Value in use should be equal to full cost of water, when it is demanded at higher sides. At this point, classical model indicates maximum social welfare.

Usefulness and utility are two postulates of values in water. Usefulness may not be measurable, except its quality but utility value is measurable in terms of returns from the water. Productivity and the price, we pay for water is taken into account in utility value. Price is again the product of scarcity. The law of equi-marginal utility applies to utility value of water; whereas, law of diminishing marginal utility applies to the concept of usefulness of the water. Qualities of water and cost effectiveness of the water supply are other constituents of the values of water.

Economic values and the intrinsic values determine the value of water. Economic value consists of adjustment for the societal objectives, net benefits from returns, flow and net benefits from indirect uses and the value to users of water resources. Intrinsic values consists of bequest value and pure existence values.

Some other postulates of value of water are, reliabilities of water supply on cost and value, adequacy of water, quality of water, timely supply reliabilities, ability to pay, recycling possibilities, purpose of water use and the time of water use. Therefore, valuation of irrigation water is considered as a very complex phenomenon.

From the plenty to scarcity, we have now reached to demand greater than supply situations throughout the world. So, water management became an important chore of the policy makers. Water harvesting, storage, distribution and utilisation became a part of institutional perspectives. Water is used for various purposes. It is conserved through various techniques. Water users of different categories have to be integrated with strategic planning and management. Of late, the water policy is not interacted in these policy circles. There are fragmented outlooks in this

respect. However, there are various reasons for this; for example, administrative and collaborative requisites are not contemporaneous with sectoral units, higher amount of investment, compliance of requisites, recovery of invested capital and water pricing. Therefore, an integrated water resource management is essential. It is a process to coordinate all development activities for socio-economic welfare with an equitable justice through legal provisions compromising with sustainable eco-system.

WATER RESOURCE MANAGEMENT

Green accounting of water is governed by the eco-system vis a vis the rain fall and its blue management technology i. e. the storing facilities like dams, reservoirs, canals, tanks and other integrated water management systems. Hence water resource management has various facets. It mainly covers the following aspects of water management;

1. Green accounting management of water resources,
2. Blue accounting management of water,
3. Distribution accounting management of water,
4. Water transport mechanism and
5. Farm level (or crop wise) water management.

"Green Accounting" of water management depends on the management of the eco-system for better and timely monsoon. A disturbance in the eco-system becomes critical with the rise in pollution. Maintenance of the "green accounting" is a fundamental requirement to manage the eco-system.

"Blue Accounting" of water management includes the art of rain harvesting through water storages, reservoirs, dams, ponds, tanks, percolation tanks and lakes. The use of the available water resources cover up this.

Distribution of water resources covers supply of water to the scarcity areas. It mainly includes canals, lifting and transporting of water. Water supplies through gravity also fall under the distribution mechanism.

Water transport covers again canals, water supply by gravity and direct or stage lifts by pipelines. Virtual water transport is another mechanism of water transport, which is valued on the basis of consumption of agricultural goods, since it requires water to produce such goods, e.g. example; for the production of one kilogram of sugar, if 15 litres of water are required, then we can say that, the person who has consumed one kilogram of sugar indirectly used 15 litres of water simultaneously.

Farm level water management depends on the crops, climate, seasons and the topography of the region. Flow irrigation, sprinklers and drip systems

are some of the modern methods of using the water resources for irrigating the crops/farms. Normally, our farmers supply water to the soils and not for the crops. The demand for water expressed by the farmers and the demand for the irrigation water required by the crops differs. The supply of water becomes rational and equitable, when it fetches the biological need of a crop.

To bring equity, justice and equality postulates of water management practices in all above aspects, it needs a special attention with technology, people's participation and the required legal support. The Murray-Darling River system is one of the best models of institutional structures for developing countries.

With rise in the income level, the percentage use of water for agriculture sector declines and that of industrial share increases (World Bank Report 1998-99). It means development does matter with the rational use of water resources. Some of the experiences of water management practices and operations are explored by Mark Svendsen (2005). The water resource management has various aspects. By region, space and time, it changes with functional local feasibilities.

Financing of agricultural irrigation is becoming a resilient chore. The public investment in the sector is declining. On the contrary, due to its structural limitations, the private sector is not interested in long-term/capital investments. Long-run structural irrigation reforms are essential in developing countries. Public confidence has to be insured through awareness. The equitable water distribution in Chikotra river basin ensures the public participation in sharing the cost and confidence of the local leadership in the basin.

The financial allocation as an important part of water management through Govt. agencies is now becoming inadequate due to rise in demand for water. Besides, the rising demand for food grains is also intensifying the demand for irrigation water, which is again essential for survival of human being on the Earth. An entry of private investment will bring structural changes in the water sector. The brass-tacks of such investment are obviously intends to charge remunerative prices for water supply. Hence, bulk water pricing model is adopted in pricing of water at the dam level. The corresponding water distribution methods are also followed by the *pani parishad*.

EQUITY AND EFFICIENCY

Equity, efficiency and justice are the main components of the welfare economics replicated in the water distribution model of Chikotra. Equity and efficiency are two important postulates in water allocation methods. Justice is another measurable entity accompanied with this. Equity is

nothing but an attainment of average values, whereas efficiency is closely related to the productivity. The costs and benefits of an economic activity are comparatively taken into account, while measuring the efficiency. Efficiency is thus, a net value addition to the beneficiaries. Efficient allocations of water resources are very important in maximising the net benefit under the existing technologies. All persons, animals, birds and living organism on the Earth are equally entitled to get the benefits of available natural capital (resources). Environment and ecology itself is a capital, because it nurtures and cures the living organisms on the Earth, hence it is termed as a natural capital. Water is a very important capital for survival of all living beings on the Earth. There is a controversy and conflict in ownership of water resources among the diversified schools of thoughts. The Neo-classical School believe in private ownership for efficient use of the resources; while modern school of thoughts emphasises its joint management and joint ownership as the efficient system of resource allocation.

Value of water thus, varies considerably across the season, crop, region, climate, quality of soil, slope of land, drainage, irrigation management, rotation period, rotation counts (in case of pricing per rotation), price (simplicity), efficiency, subsidy or taxation, rainfall, political considerations, supply of electricity, structure of irrigation, number of users and like other factors.

The first layer of the equity should refer to the available water resources and its storage system under the given topography and geography. The vulnerability of the displaced persons should get proper justice. This may be the second phase of equity and justice. The demand and supply of the water resources should be adjusted with equity principles in the third phase. The supply constraints cannot be neglected or eliminated since they are the natural factors at this stage. In fact, the beneficiaries should adjust with their demands. The distribution of water on the basis of the population in the command is next equity principle. Similarly, equity in water supply to different crops and plants needs to be considered. The non-land holders should be given cultivated lands for cultivation during the next corresponding phases of equity. Redistribution of land resources is not possible in the given Indian conditions. But, the cultivable lands of absentee landholders (who are actually not practicing the agriculture) can be allotted to such potential farmers (mainly agricultural workers) on rent basis or on the share cropping basis at the end of the equity paradigm. The social mind has to be created for implementation of equity and justice in a region or river basin. This aphorism has been seriously considered in the Chikotra River basin.

Equity, efficiency and justice remained the chief concern of equitable distribution of water in the Chikotra River basin. Maximum social advantage

should benefit equalizing the marginal social sacrifice (or marginal benefit) in the absence of taxes and other distortionary constraints (e.g. politics, social aspects, information etc.), allocation is maximized with equalisation in both sides (i.e. maximum social advantage = maximum social sacrifice MSA= MSS). The net benefit arrived on such conditions is known as first-best or Pareto efficiency. According to Johansson (2005) under certain conditions (full information, no externalities, perfect competition, complete certainty and non-increasing returns to scale), markets would achieve first-best allocations.

Equity is confined and identified in different circumstances. For example; equity in income distribution, (inter and or interclass or interpersonal), equity in water charges (irrespective of size class and region), equity in cost recovery (ability (judged through income, wealth, cash crop) to pay and benefit (returns from the use of water) to pay), equity in environmental or ecological costs, (e.g. high prices for food grains using less water and low prices for inefficient use of water), equity in services and cost (high price of certainty, adequate timeliness and quality of water) equity in uses (producer and consumer) equity in priorities (between agriculture, non-agricultural uses) etc. to find out an operative mechanism to follow all these equity is a challenge. Though not now, in future the people of Chikotra River basin may thought of possessing these equity hypothesizes. And that will be a mile stone model of water distribution in the world.

Equity in cost and price, are some of equity axiom in irrigation sector, which has a link with efficiency dictum. Equity in irrigation sector is mainly governed by cost and income of irrigation project. Rajan K. Sampath (1992) has endorsed two schools of thoughts in irrigation. Equity problems are handed through taxation and transfer schemes and not through irrigation subsidies are as objective which deals with equity. Another supports in development and distribution of irrigation objectives. The cost and revenue management in the Chikotra river basin is followed through the Water Users Associations in the basin.

Equity concern includes recovery of cost from water users subsidised food production and income redistribution (Selegraves and Easter, 1983). There are the options or constraints in the second best theories. Income redistribution criteria for water pricing have a merit on ethical grounds (Rhodes and Sampath, 1988, Sampath, 1991, 1992). But this becomes impracticable in collective groups like; Chikotra Equitable Water Distribution model. Awareness and sacrifice are essential in the group-ethics. It further helps to reduce implementation costs. Water pricing cannot control redistribution of income, but if the govt subsidy enters in the pricing mechanism to some extend redistribution of income becomes effective. Donors of the cultivable land submerged in the reservoir no doubt express

sacrifice, but compensation is paid to such families through package programmes.

Equity and efficiency are conflicting ideas in water sector. However, promotion of efficiency will improve equity in long run, but no in case of vice-versa (Sampath, 1984, 1988a & 1990b). There are number of empirical evidences to support this situation. Supplying of water on hour basis to a particular size of holding is proportionately follows equity principle in collective action sector. But cost and revenue principle is widely accepted criteria of equity. Costs are always inflated so as to recover higher revenue from irrigation investment. This is the case with Govt. sector also. Corrupt practices motivate to hike the operation and maintenance (O and M) cost and even project cost. People's participation in irrigation projects (Baliraja dam project in Sangli district of the Maharashtra state) minimises the cost of project. Normally, Govt borne the burden of cost and benefit is retained with the beneficiaries of the blue water (water storage) devices, where the cost of lifting and canalising of water is borne by the stakeholders of the WUAs. In the case Chikotra the costs are shared under 80:20 basis. The maintenance cost is borne by the respective WUAs.

Equity and efficiency are essential characters of water pricing. But trade-off is difficult (Small and Rimal, 1996). Redistributive water pricing policies are proponent and fairness in social awareness and appeal the policy makers in a democratic set-up. But this distorts the production decision, it works effectively only when the water users belongs to heterogeneous groups. This policy helps to avoid migration and creates jobs in local areas.

Pareto efficiency and the first-best

An allocation of water maximising the total net benefit is called Pareto efficiency or the first-best. The maximisation equilibrium, if involves short term variable costs results to short run efficiency. When long run costs are included in the maximisation problem, Parato efficiency in allocation is achievable. When trades are free from Govt constraints and high transaction costs, the resulting price will be equal to that determined under marginal cost pricing methods and the resulting water allocation will be Pareto efficient. And when maximisation occurs under distortionary conditions or constraints, (like political and social welfare concepts) the allocation is termed as second-best efficient (Tsur and Dinar, 1997). To find out fairness in pricing under such condition is very important. It is very difficult to define fairness in Indian conditions.

Rawlsian concept of 'fairness'

The Rawlsian concept of 'fairness' in equity pricing seeks to maximise the welfare of the last well off in society. Based on this reform, strategies are

required to be developed. The Rawlsian concept of fairness to investigate equity in India's irrigation systems is used by Sampath (1992). It seeks to maximise the welfare of the well-off minority in a society and allows one to evaluate reform strategies in these terms (Johansson, 2000)

The fairness in water allocation is that where;

i) The beneficiaries must use water economically. There should not be waste of water, loss of soil fertility and loss of the yield of the water.

ii) The supplier should also get remunerative price. Equal to his sacrifice calculated in terms of capital cost, O and M and other miscellaneous expenses.

iii) The supply of water should not be at the plenteousness. The scarcity norm should apply only when the pricing is considered.

iv) Farmers awakening play a very important role in water use, maintaining crop yield and soil fertility safely.

v) Income redistribution through pricing mechanism is not effective. It may be a Govt's interest to introduce such things for the citizens and sectors in an economy.

vi) There should not be any provisions for subsidies in the market based water markets. If so, it should be compensated with equity and farness. Disparate pricing mechanism creates corruption and red-tapeism in the administration. Social subsidies may be routed through other channels.

vii) The fairness involves in better management of the WUAs and transferency in their business. The managerial problems can be removed through policy decisions.

Fairness in water distribution is adoptedin the Chikotra model. It will be a mile stone in the history of water management if implemented properly and followed by the public. However, the task remains with the managers who initiate and implement the model. Implementation of such policy decisions lies in dividing the benefits at partial and general terms. An appropriateness of the policy objective though separate involves societal environment. Unlike the policy and management e.g. tussle between regulation and administration or management, the division between partial equilibrium and general equilibrium are essential in pricing mechanism. Both are considered as an important tool of economic analysis (Rogers *et. al,* 1998).

WATER PRICING AS AN INDICATOR OF EFFICIENCY, EQUITY AND INVESTMENT

The water pricing is considered as an indicator of efficiency, equity and investment. Efficiency is influenced by supply of water and the users' demand

for water. Supply of water depends on the public investment in irrigation projects and their completion period. The feasibilities and the economic viabilities of the projects are also important parameter in testing the rate of returns. Internal rate return (IRR) is the best method to diagnose the efficiency in resource allocation. The equity norm depends on the welfare concept of distribution of the benefits. The burden of rehabilitation caused by the project should be met by the beneficiaries themselves. The first equity concept begins with the plan of rehabilitation. The resource distribution equally among the population not the beneficiaries alone, it is in fact the first step towards equity. The allocation of resources based on the cropping pattern is the second phase of equity. The justice comes when resources are distributed under the law of equi-marginal utilities i.e. a rupee spent on poor should reward the poor equal to the reward gained by the rich by spending a rupee on them. So, the spending should not remain equal but the benefits obtained by both should remain equal. This is in fact, doable through the inclusive growth model. Most of the Govt investments do not bring equity in costs as well as benefits both to rich and poor. Hence, equity in all respect is difficult to be introduced and implemented in respect of justice and equity paradigms. However, it can be brought under stratified layers like users and uses of irrigation water by categorising the resources and their benefits.

Six essential arrangements

The essential arrangements for efficient, equitable and sustainable water market are governed by the institutional arrangements, management and infrastructure. Perfection and the sustainability always suffer in the water market because of the water illiteracy. Scarcity postulates makes the users more rational. In fact, scarcity becomes the base of the water pricing. Otherwise water has no exchange value, if the supply exceeds the demand.

The perfection in market conditions will achieve first-best allocations. But this needs the water suppliers and water traders belong to the private sector, without Govt intervention. The private players in the market always exploit the others. If this is true, perfection becomes doubtful. Private players are rational in utilising the water resources, provided it rewards the returns. Otherwise an entry of the private players is not possible.

Easter, Becker and Tsur (1997) have listed six essential arrangements for an efficient, equitable and sustainable water market.

They are as under:

1. Institutional arrangements, which establishes water rights that are separable from land rights. Such water rights are provided in the Chikotra river basin.

2. A management organisation is needed to implement water trades. The WUAs are being established of late as a Govt policy.
3. A flexible infrastructure is needed to transfer qualities of water.
4. Third party effects (externalities) must be internalised by the system.
5. Water conflicts require effective elucidation mechanisms. The WUAs is the best organisational set up for this.
6. Equity concerns, such as future and social goals, needs to be addressed. These things are well set in the Chikotra river project.

Imperfections in water market

Any disequilibrium is caused by imperfections in supply and/or demand (users + uses) of irrigation water, hence, exploitation persists in all stages. Govt. as a supplier with its own (public) investment may be exploited by the users for various uses, by paying less or no payments for irrigation. The private payers (investors) in the irrigation sector may exploit users and uses by charging more than per unit cost of irrigation. So, privatisation is being opposed by the stakeholders in the sector.

In the case of externalities or the second best, the exploitation further persists due to wasted interest, lack of information and political considerations in a democratic set up. The principle of marginal costing works only under perfect competition, which in fact does not exist. The first best however, would consider such issues under irrigation pricing.

High irrigation prices are supported, when the water resource is inefficiently used. This kind of inefficiencies may cause salinisation, water logging, groundwater contamination and soil degradation. This is a kind of environmental cost recovered by high prices. Therefore, irrigation costs should also include environmental cost (of abatement) which can be reflected in irrigation prices during a long run. There is atime to decide the pricing postulates for the Chikotra, since it is in the erection stage. But it has to be decided well in time.

Besides, water supply component should also consider certainly, adequacy, timeliness and quality of irrigation water. These factors widely influence the irrigation pricing. Supply depends on flow and extent of pipe line (distance of crop to be irrigated and the point of flow of water. Rotation depends on demand and nature of crop. Closed supply of water (sprinkler and dripping) is more efficient; hence, it can be underpriced, though cost remains high. The environmental benefits and crop yield benefits rather remain higher than other mode of irrigation. The Chikotra model insists on such technologies indefatigably.

The equilibrium in water markets is very difficult due to various imperfections in the water markets. Socio-political issues play a dominant

role under equity concerns. Besides, the implementation cost recovery also becomes hard. Marginal cost = marginal benefit necessities the equilibrium to the possible extent. But the attainment of this equilibrium is very difficult in water markets due to the imperfections in the water markets. An imperfection in the other related markets also brings imperfection in water markets.

The first best and second bests are the partial equilibrium paradigms. Pareto optimality is the best example of the first best. The second best considers the implementation cost and other socio-political considerations. Hence, it becomes very difficult to come to a particular level of pricing. There exists various peculiarities in water services; consequently, water pricing becomes difficult and complicated. The issues like, implementation costs, which also include convergence cost, water losses and other application practices, Govt. or public intervention is essential in such cases. All promising 'bests' are essentially be implemented and considered in a democratic set up like India. Chikotra will stand as the one of the best model in water management.

WATERSHED MANAGEMENT AND EQUITABLE WATER DISTRIBUTION IN CHIKOTRA BASIN

Location

Chikotra River is a small river, about 40 Km in length, in the southern part of the Kolhapur district. It connects to Vedganga which meets Dudhganga after crossing the state border of Maharashtra. Lastly Dudhganga connects to River Krishna in Karnataka. The river valley consists of 32 villages from Kagal tehsil, 15 villages from Bhudargad tehsil and 5 villages from Ajara tehsil. The river Chikotra originates in Bhudargad Fort range, about 30 km east of Western Ghat, at the height of 750 m near Bediv village. The location of the basin coordinates at 16°18'10"N 74°14'27"E. The height of the Bhudargad Range is about 800 - 1000 m. The river bed level reduces further from 750 m to 550 m. The average rainfall in the basin is around 1400 mm. Rainfall at the origin of the river is around 2500 mm and at the tale end, where Chikotra River meets Vedganga, is around 750 mm. The temperature in the basin is around $26^0 – 29^0$ c during summer (March to June), $22^0 – 25^0$ c in winter (November to February) and $23^0 – 35^0$ c in monsoon (July to October).

The Chikotra River Basin is actually a watershed marked as KR74. The essential functions of the watershed management rely on planning, distribution and monitoring of the irrigation projects. The formulation of plans for the management and development of water resources in the basin is the fundamental functioning of the irrigation projects, by which the water demands of different sectors are brought in line with water supply. Allocation

and distribution of water resources is the mechanism and criteria by which bulk water is apportioned among the different uses.

Blue water management in Chikotra basin

The watershed of Chikotra river basin is demarcated as KR.74 by the Groundwater Survey and Development Authority (GSDA) of the State Govt. The watershed covers 52 village areas scattered in three tehsils of Ajara, Bhudargad and Kagal of Kolhapur district with 32, 765 hectares of geographical area. Of which, 24,766 hectares (75.58% of geographical area) of land area is currently under cultivation. Only 37.87 % of cultivable area (9, 400 hectares) can be irrigated by the traditional method of irrigation as estimated by the Govt irrigation expertise. By the equitable water distribution with drip system at the rate of 4000 cubic metre per hectare, around 63.30 % of cultivable land area (i.e. 16,025 hectares) can get the irrigation facility.

There are seven sources of green accounting of water supply in the Chokotra river basin comprising;

1) Chikotra Dam main, with 38.71 million cubic metres (MCM) of water supply potentials;
2) Naganwadi with 8.44 MCM of water supply;
3) Karanjivane MI tank with water potential of 1.51 MCM;
4) Madhyal MI tank has potentials of 3.82 MCM;
5) Benikre MI tank with water supply potential of 1.82 MCM;
6) Hanabarwadi MI tank with 2.67 MCM and
7) Water potentials created through water conservation is about 6.44 MCM. The total blue water stock is around 63.41 MCM.

Uncontrolled cropping pattern

At present there is no control over the cropping pattern. More than 65 per cent of the uncontrolled cropping pattern is shared by sugarcane; when only 14 per cent is permitted under the permitted cropping pattern for the Chikotra Medium Project. Uncontrolled use of water results in salinity in low lying areas. The remaining areas get a hold of inadequate water due to irregularity of water supply. This is due to the fact that the pumps have to irrigate more areas than they are permitted for. As a result, the yield per acre has come down to 30 metric tons of sugarcane. Most of the people do not have access of water. Hence, the action plan is oriented towards judicious use of water. Small farmers do not sustain irrigation investment. However, there are some private lift schemes, who allocate their excess irrigation water to the neighbouring small farmers by charging the water rates by 1/

4th of the yield sharing basis, which is much higher than the prescribed water rates of the State Govt. Paddy, groundnut, soybean, are the main Kharif crops in the remaining area of the basin. During the Rabbi season, tobacco, jowar and wheat crops are cultivated.

Investment in water sector

The basin belongs to the high rainfall zone. So, Kharif crops are assured. The flowing water is used for irrigation even during the Rabbi season. Water becomes scarce during summer season. Irrigation water is needed for cultivation of sugarcane and other plantation crops. Water storage becomes inevitable for crop planning throughout the year. There are potentials of water storages at various places like Madhya. The KT weirs and pick – up Weirs in the river are the main source of water during the Rabbi and summer seasons. Collective action is inescapable for common benefits.

The hill based farmers do not invest even collectively due to high cost of lifting the water. The land area is fragmented with small areas. Besides it is being developed on the plateaus and the slopes of the hilly areas. So, irrigation planning has various limitations. However, some private investment in irrigation sector is made by the well to do families. They are marketing their water to the nearby land areas at a very high cost of water pricing. Flow water irrigation method is used for crop cultivation. Drip method is in fact, the proper method of irrigation for the tilt zone, but so far, residents are not found interested in such modern methods. They are traditional in irrigation water supply to the crops.

EQUITABLE DISTRIBUTION – AN INNOVATIVE EXPERIMENT IN CHIKOTRA BASIN

Drip irrigation method increases the area under irrigation. Besides, it saves the soil and crops from salinity. Assuming a family of 5 persons, each family will receive 1600 to 4000 cubic metre of water for irrigation. Every family can irrigate on an average 1 to 2.5 acres of land area under drip irrigation method. Every female landless woman will get at least 10 *gunthas* of land and 400 c. m. of water for her livelihood and a landless worker or a marginal farmer can irrigate one acre rented land with his quota of 1600 cu. m of irrigation water.

There is equity in relative and absolute terms. Landless and deserted women also get an opportunity of livelihood by share cropping; hence there is a justice in the water distribution model. Similar equity is also found in crop wise distribution of water by controlled cropping pattern.

Equity and efficiency in Chikotra Pilot Project

The origin of the demand for equal distribution of water in Chikotra valley emerges from the *Pani Panchayat* programme of Shri Vilasrao Salunkhe in

Table 1
Equitable Distribution of Water in Chikotra River Basin: village wise data

Sr. No	*Villages*	*Population (as per Census 1991)*	*No of families*	*Geographical area*	*Cultivable area*	*Water availability after distribution of water per head (pop x800 cu. m.) (in cu. m.)*	*Irrigated area under equitable distribution of water (in ha.) Govt. Plan*	*Irrigated area after equitable distribution of water @4000 cu.m per ha. Federation Plan*
1.	Zulapewadi	1425	319	322	270	1136438	102	284
2.	Chimane	1376	331	462	441	1097360	167	274
3.	Begavade	1083	204	631	224	863693	85	215
4.	Bediv	477	116	1115	309	380407	117	95
5.	Aralgundi	1400	311	1217	132	1116500	50	279
6.	Pimpalgaon	2394	5333	647	493	1099215	187	477
7.	Bamane	985	2113	408	246	785538	93	196
8.	Pangire	1375	298	481	390	1095563	148	274
9.	Naganwadi	469	110	297	168	374028	64	93
10.	Helewadi	511	102	167	135	407522	51	286
11.	Belewadi-Hub	1439	310	592	406	1147603	154	381
12.	Dhamane	1912	420	869	729	1524820	276	349
13.	Mangnur	1751	386	464	431	1396423	163	381
14.	Hasur-khurd	1911	380	661	459	1524023	174	304
15.	Hasur-budruk	1528	281	564	393	1218580	149	331
16.	Kasari	1665	381	506	408	1327838	155	290
17.	Alabad	1457	286	469	409	1161958	155	311
18.	Nandhyal	1563	255	654	552	1246493	209	254
19.	Arjunwada	1277	234	398	389	1018408	147	569
20.	Hamidwada	2854	534	1042	927	2276065	351	544
21.	Khadkewadi	2733	539	722	666	2179568	252	310
22.	Belewadi - kal	1557	333	599	478	1241708	181	242
23.	Vadgaon	1214	252	462	452	968165	171	349
34.	Tamanakwada	1753	350	763	564	1398018	214	1056
25.	Kapashi	5301	1113	966	796	4227548	301	271
26.	Munali	1360	273	399	375	1084600	142	171
27.	Jainyal	1252	236	501	310	998470	117	249
28.	Karadyal	1023	183	438	414	815843	157	203
29.	Metage	949	198	336	312	756827	118	189
30.	Galgale	1498	296	610	562	1194655	213	298
31.	Lingnur	1666	339	529	480	1328635	182	332
32.	Bahirewadi	3128	592	1399	1314	2494580	498	623
33.	Nangergaon	752	174	383	247	599720	94	149
34.	Pal	861	180	347	341	686648	129	171
35.	Bhendvade	853	154	386	372	680267	141	170

contd. table 1

Sr. No	*Villages*	*Population (as per Census 1991)*	*No of families*	*Geographical area*	*Cultivable area*	*Water availability after distribution of water per head (pop x800 cu. m.) (in cu. m.)*	*Irrigated area under equitable distribution of water (in ha.) Govt. Plan*	*Irrigated area after equitable distribution of water @4000 cu.m per ha. Federation Plan*
36.	Barave	1734	334	637	607	1382865	230	345
37.	Dindewadi	1423	300	722	461	1134843	175	283
38.	Murukate	666	130	500	86	531125	33	132
39.	Manavale	1294	254	1047	201	1031965	76	257
40.	Bolavi	1433	299	763	863	1145210	327	286
41.	Thanewadi	369	60	236	234	294277	89	74
42.	Bolaviwadi	710	143	346	311	566225	118	141
43.	Haladvade	781	171	144	122	6228475	46	155
44.	Karanjivane	1600	327	595	531	1276000	201	319
45.	Haladi	2450	466	972	906	1953875	343	488
46.	Madhyal	4014	779	1200	931	3201165	353	800
47.	Hanaberwadi	1292	253	674	358	1030370	136	257
48.	Baleghol	1784	334	1134	812	1422740	308	355
49.	Belewadi-Mas	1758	388	682	802	1402005	304	350
50.	Balikre	432	78	392	361	344520	137	86
51.	Benikre	1531	326	1059	976	1220973	370	305
52.	Arjuni	1490	288	746	663	1188275	251	297
	Total	79516	16149	32765	24819	63414010	9400	15717

1980s. The Common Minimum Programme (CMP) was announced by the Democratic Front Govt of Maharashtra on 10th of March, 2000 which included the plan of equal distribution of water on the basis of population for mitigating the sufferings of the poor, deprived and exploited population. Besides, the state water policy was to be so designed as to raise the standard of living of the exploited, excluded and deprived population. Permission to lift the irrigation water was to be given to Co-operative Lift Irrigation Societies. So, villages in the valley have proposed to establish Watershed Management and Water Users Associations (WMWUAs) and their formation of the Federation. An equitable water distribution through drip irrigation was thought essential only because of the reason that, the drip irrigation method doubles irrigated area where the deprived families can be accommodated without disturbing those already benefited. Another reason is that the farmers are having very small sizes of their land holdings without any log on to flow irrigation due to hilly slopes of the landscapes. So, the task is how to distribute irrigation water to the small and marginal farmers in the valley.

On 15th January, 2000, a State Level Water Summit (*Pani Parishad*) was held at Pune under the leadership of a prominent activist in water distribution in Maharashtra viz. Vilasrao Salunkhe and a great thinker Justice P. B. Sawant. It was initiated by Anandrao Patil; a prominent personality in the Chikotra River Basin. Under the leadership of Justice B. G. Kolase-Patil, who was elected as the president of the Council for Equitable Water Rights (CEWR), a Summit of 5000 farmers from the Valley was organised by Anandrao Patil in Pangire village on 19th March, 2000. The summit accepted the principles of integrated water resource management, equitable distribution and efficient and economic use of water. The draft of the equitable water distribution in Chikotra Basin on population basis was designed and submitted by the *Parishad* to the Govt of Maharashtra, on 24th April, 2000.

The Second Water Resources Commission under the Chairmanship of Madhavrao Chitale had just submitted its report to the Government of Maharashtra. In March 2002, the state Govt appointed one man commission of Dr. Chitale for recommendation on the draft of the Parishad which was registered as "Council for Equitable Water Rights. The draft was scrutinised by the Commission and granted approval for its implementation in all the 52 villages of the valley in groups of 5 villages in a lot. Under the leadership of Anandrao Patil, an equitable water distribution model was developed by the SOPPECOM, Shramshakti, Gramgaurav, Gomukh, AFARM and other NGOs working on the same issues. This model is proposed to be implemented in 6 villages as a Pilot Project and then to be replicated in rest other 47 villages in the valley.

The Chikotra River Valley Project consists of the main dam at Zulapewadi, MI tanks and KT Weirs on the run off of the river and down stream flow of water in the command of the river (see map). Initially the KT weirs were built first and later the dam. An opposition for the construction of dam lingered the project some years.

Objectives of the Pilot Project

This project aims to achieve the following goals.

1. Sustainable development through participatory approach.
2. Conservation and protection of natural resources like, land, forest and water.
3. Economic and integrated common management of water from all sources.
4. Equal distribution of water village wise on the basis of population.
5. Equitable distribution after which minimum required water for agriculture will be allotted even to landless farm labourers and deserted women.

6. Public (Govt) Private (WUAs and their Federation) Partnership rather than mere participation.
7. Conservation of environmental foot prints.
8. Eradication of poverty.
9. Eradication of local unemployment.
10. Growth of all with involvement of all.
11. Provision of minimum food and water security.
12. Water to all rain fed area by divergence efforts and replica model.

Irrigation water is not supplied on the volumetric basis today. The metre system is proposed to be installed at the water-lifting pumps of the WUAs.

Equitable distribution of water in the basin

"Green water management" is environmental functioning of the ecosystem.

Monsoon is an environmental functioning of the eco-system. It depends on the human interaction with the ecosystem services. Climate change is the outcome of the mismanagement of the green accounting of the ecosystem. The "blue" water management systems belong to the macro level planning and implementation of water conservation activities to be introduced by the State through dams, reservoirs, tanks, canals, and underground aquifers.

The farm level, crop level or individual level distribution of water is a micro level activity being practiced by the WUAs. Management of water distribution has three dimensions, viz. technical dimension, where we have to plan, design and operate the water distribution system. Secondly, social dimension, where we have to create awareness, expose the collective action, local leadership, withering away the local oppositions and protections from the vested interest groups; and thirdly, elimination of the day to day problems in the actual water distribution systems. Change in the mindset of the people is one of the hurdles in equitable water distribution. It requires enormous efforts for gearing up the collective action in its mechanism.

While preparing the water distribution system or model, following principles are to be referred properly; (WALMI, 1992a)

1. To bring appropriateness in the distribution,
2. Equity,
3. Environmental stability and sustainability
4. Predictability,
5. Timeliness,
6. Flexibility

7. Incentives to the users
8. No scope for mal-practices.
9. Users' control
10. Supplier's control

Equitable water distribution has different nuances like; regional, area, crop, and individual specific. It can be;

a) Equitable water distribution by population
b) Equitable water distribution by crops,
c) Equitable water distribution by region,
d) Equitable water distribution by season,
e) Equitable water distribution by uses of water and
f) Equity in rotational distributions (users, outlets, need based) etc.

The equitable water distribution system was thought and discussed in principle since long. Particularly, the eight months and twelve months water utilisation models were thought on the background of the droughts in the State during 1970s. Dandekar Committee on regional imbalance had referred the issues seriously. Under the Common Minimum Programme, equitable water distribution was supplementary in the context of the Chikotra River Valley Project. The medium and minor irrigation projects in the valley were brought under the programme. The available water is equally distributed among the village on the basis of population settled in the Chikotra river basin.

The consolidated water reservoir capacity of the Chikotra River Valley projects is confined to the overall capacity of the Chikotra Medium Irrigation Project (CMIP), 18 pickup Weirs and 8 KT Weirs constructed in the downstream of the dam and the minor irrigation tanks (MITs), which stands to around 6, 34, 14,010 cubic metres of water storage by all means, i.e. 2.24 TMC. This irrigation water is available for irrigating 24,765 hectares of cultivable area of 52 villages. Per hectare availability of water including precipitation is around 25,561.63 cubic metres in the valley. The per capita availability of water will be 797.5 cu. m. The prevailing level of irrigation water per hectare in Maharashtra is 9000 cubic metre. However, it is fixed at 6000 cubic metre for Chikotra Project. The *Pani Parishad* has estimated the availability to 16025 cu. m. The equitable water distribution model has determined at the level of 4000 cubic metres per hectare assuming a family of five persons with 797.5 cubic metre of water available for an individual in the valley. Most of the rain water runs away through the river run off. It cannot be stored fully. Only 25 to 30 per cent of rain water is stored in the valley. This needs to be further channelised for the use of irrigation purpose

towards the down streams. The inter-state water distribution model can be set with the Karnataka State.

The volume of water is proposed to be lifted by electric motor pumps in two stage (or first lift in some cases) through a rising main pipe line with a convenient distributive channels (see sketch). There is no possibility of canals in the region due to the hilly slopes around the command. Most of the watersheds are hilly with small pieces of terracing cultivable lands. Water distribution by flow method to these small and scattered lands is not expedient. Moreover, it is not opportune and cost effective. The collective groups/WMWUAs have been already formed in the villages. Some villages are yet to establish their WMWUAs.

CONCEPT OF WMWUA

Lifting the water from reservoirs or KT weirs or pick up weirs and irrigating the lands by drip is the modern method of irrigation to be adopted by the villagers in the basin. This is the only alternative for equitable and judicious distribution of irrigation water. The total population of the 52 villages as per the Census of 1991 was 79, 516. This population is entitled to receive 6, 34, 14,010 cubic metres of water available in the basin. This water is equally distributed among the existing population. Per head availability of water is around 797.5 cubic metres. Population of a village multiplied by 797.5 cubic metres is the quota of that village. This quota is to be distributed equitably, and not equally, among the villagers. Equitably distributed water considers the landless, agricultural workers and the deserted women in a broader sense of social justice. The villagers settled in urban areas have retained their ancestral ownership of land through share cropping or rental basis. In such cases the irrigated land area increases and can cross the limit of irrigation land area fixed by the WUAs under equitable water distributed model. It has been decided at the minimum quota of 1600 cu. m for 1 acre is planned to be allotted to all the landless workers and marginal farmers. This minimum quota is allotted to each resident of the valley as their water right. The non-users of these water rights can surrender their water rights to the WMWUAs. They are not entitled to transfer their water rights independently. The WMWUAs are entitled to distribute the available water to the cultivable land areas. The cropping pattern is decided by the WMWUAs, with the consent of the cultivators, on the basis of 4000 cu.m per ha.

There shall be one discharging valve for every 4 to 8 acres of land area. The Block of about 50 acre shall have a water metre for measuring the quantity of water consumed. The farmers of the valve-command have to pay the water charges as per the metre equally on the basis of the area. This valve-command shall have the single common cropping pattern commonly decided by the farmers.

The agricultural workers and the landless workers can also get the cultivable lands for cultivation as per the scheme of the WMWUAs. The land holdings of the non-residents of the villages, non-cultivable village lands or *Gayaran* (owned by the Gram Panchayats) and the *Deveshtan* (Temple lands) lands are proposed to be allotted to the agricultural workers on rental basis or share cropping basis.

On an average each piece of one hectare of land area receives 4000 cubic metre (1600 cubic metre per acre) of irrigation water as per the scheme of water distribution. For the cluster of 50 acres of land area, there shall be a Block Committee. This Committee is the replicated model of the *Phad* System in Maharashtra. The block system was first introduced by famous Engineer and *Divan* of Mysore Provincial State, Sir M. Vishweshvaraya. The KT Weirs are the outcome of this system. These Groups are empowered to determine their collective cropping pattern.

The Chikotra valley project is an integrated developmental activity. Water is the pull and push factor of development in the basin. The traditionalities are pushed away through an equitable water distribution methodology and the supplementary support activities are pulled towards the basin through equitable water distribution. There is a social and economic transformation brought all the way through equitable water distribution model. Hence, water plays a significant role in pulling all types of fairness and justice in the basin. Water in the Chikotra River basin has been accepted as the public good and a priced good since it is being used for economic purpose; consequently, it is having both high and low excludabilities and substractabilities. It is a price good to a WMWUA, as it recovers the costs from the beneficiaries. There is no toll good pricing model and open access goods pricing model in the project. Following categories describe the type of irrigation water as a good (commodity), which fall under the second best models. It is second best only because of the fact that it covers implementation and administrative costs and other political economy considerations.

The water services may be exchanged from one group to another group depending on the principle of equity. The technology (lift and drip) used in it reduces the economies of scale. It is owned by the landless workers, deserted female agricultural workers, small and large farmers. Block farming is useful to all. It has low excludability because of large number. It is very difficult to monitor the effectiveness of water services. Private investment in such cases remains less. Besides, large portion of subsidiary effects like floods, electricity generation may not be readily divisible for private purchase. So, there is low excludability. Now-a-day under the process of liberalisation, the huge private investment in large scale projects from the private sector is not possible in the river basin. The Public Private Partnership is more advisable.

SOCIAL TRANSFORMATION THROUGH EQUITABLE WATER DISTRIBUTION (STEWD)

The STEWD is an outcome of long deliberations of the stake holders and social thinkers, supported by the recommendations made by the Chitale Commission (1995), for the rational utilisation of water resources in Chikotra River Valley. The Commission has suggested implementing a pilot scheme of the equitable water distribution model for the cluster of 5-6 villages in the Chikotra river basin. In pursuance to this, a NGO has been registered as the Council for Equitable Water Rights in 2003. This council has played a pivotal role in establishing six WMWUAs in the valley. The required awareness campaigning has been routed through this NGO. The WUA in each village is established with local participation of farmers, landless labourers and deserted women. A Federation of all WMWUAs is established for effective policy initiatives and implementation. This Federation is responsible for planning and implementation of the lift irrigation schemes for the cluster of village users associations and for equitable contribution from villagers having lands at different heights.

Pilot project of six villages

Six villages have been selected for the pilot project. These villages were selected on the basis of the local support, leadership, economic feasibility and choice of the chief promoters. The pilot project of six villages was submitted to the Govt of Maharashtra for its approval in 2006. Various steps and queries have been attended by the Promoters. In May, 2012, the Govt of Maharashtra has approved the proposal as a replicable model of equitable water distribution in the State. The Cabinet Ministers of the State also allotted an administrative sanction for Rs.30.54 crores for irrigating 1417 ha. of land in 6 village for implementing the project. The pilot project is designed for the selected six villages located in three different tehsil areas of the river basin. They are;

1.	Belevadi Hubbalgi (Ajara tehsil),	381 ha.
2.	Bamane (Bhudergad tehsil),	196 ha.
3.	Begavade (Bhudergad tehsil),	215 ha.
4.	Belevadi Kalamma (Kagal tehsil),	242 ha.
5.	Tamanakwadi (Kagal tehsil),	1056 ha.
6.	Dhamane	349 ha.
	Total	2429 ha.

The STEWD is an integrated activity of water conservation, water utilisation and water distribution (CUD) schemes developed for the rational use of available water to a maximum possible land area and bringing

agricultural diversification in the river basin with increasing agricultural yield and nutritional values.

Water Users' Associations

All these villages are having Co-operative Watershed Management and Water Users Associations (WMWUAs) established for the equitable allocation of irrigation water among the members.

These WMWUAs have formed the Federation, known as Chikotra Valley Co-operative Federation of Watershed Management and Water Users Associations Ltd. (CVCFWMWUA).

All these institutions are having their own constitution and bye laws framed and registered with the Co-operative Department of the State Govt.

Membership of the WUAs

The membership of the WUAs is open to all villagers irrespective of their land holding. Each individual receives the water at the rate 4000 cu m per hectare or 800 cu m per person. The 20 per cent project cost is being shared by all villagers at the rate of Rs. 22,000 from each beneficiaries and State Govt is contributing 80 per cent of the cost i.e. Rs. 88,000 per beneficiary. The villagers have established the WUAs. Each villager is expected to be a member of WUAs. The membership is optional.

All villagers (land holders and non-land holders) can be the members of the WUAs. Each member is expected to pay the beneficiary contribution and the membership fees as decided by the WMWUAs. At present the individual financial burden of the cost of lift irrigation scheme is shared at the rate of 5% of the cost in cash payment and rest other 15% is paid in the form of Bank loan. The Bank loan is optional. An individual can subscribe 20% share directly without taking the help of the loan. The 80% of cost burden is shared by the Govt.

The membership of WMWUAs is classified into four main groups, viz., large farmers, mediumfarmers, small farmers and the landless;

1 Large farmers are the land owners with more than 6.001 ha. (i.e. more than 15 acres) of land area,

2 Medium farmers are the land owners with the size of holding from 2.001 ha to 6.000 ha. (5 acres to 15 acres) of land area.

3 Small farmers vis a vis agricultural workers are classified into four groups;

   (a) Land owners with the size of holding from 1.001 ha to 2.000 ha (i.e. from2.5 acres to 5 acres) of land area,

(b) Land owners with the size of holding from 0.400 ha to 1.000 ha (i.e. from 1 acre to 2.5 acre of land area

(c) Land owners with the size of holding from 0.201 to 0.400 ha.(i.e. from 20 gunthas to 1 acres) of land area.

(d) Land owners with the size of holding from 0.000 ha to 0.200 ha (i.e. from 0 to 20 gunthas i.e.1/2 acre)

4. Landless families are further classified into;

(a) Agricultural workers' families

(b) Individual female workers (deserted *(Niradhar)* women).

Financial burden sharing

The financial burden of the project was estimated to around Rs. 90,000 per acre in 2010 -2011. The financial implications are pulled under the shared burdens. That is, 80 per cent of the funds are impending from the Govt aid, remaining 20 per cent is being shared by the farmers of all categories, consisting of 5 per cent in cash payment and 15 per cent in loan forms. At present the farmers are contributing up to Rs. 4500 per acre in cash form if loan is borrowed. Loan is optional. If loan facility is not been opted then, a beneficiary has to pay Rs. 22,000. A farmer can contribute his 20 per cent share in cash directly. The cost of lift irrigation schemes differs from village to village. But all the farmers will pay the same amount per acre as the average cost will be calculated after taking into consideration the total cost of all six villages.

Water conservation

Water conservation is planned by constructing farm ponds at the foot of the hilly area. The pond water can be used for the crops grown at the terracing slopes and plateaus of the hilly areas. As the rainfall remains high in the area, the farm ponds can be filled by rain water during the monsoon. The river basin falls under the high rainfall zone of the State during the monsoon. The scarcity of water arises during the post-monsoon seasons. The Chikotra River Project is having 8 KT Weir 18 pickup Weirs constructed at the downstream and upper run off of the river basin. More than 150 days the water flows in the river, which is now lifted by electric motor pumps for irrigating the lands in the hilly slopes of the basin, during dry spells. After erection of drip irrigation schemes, this water will be available for free during the monsoon.

Water utilisation

The water from the pickup weirs or KT weirs is lifted directly from the dam reservoirs up to the possible height. The plan of lifting vis a vis cost of

elevating differs from village to village as the topography differs from place to place. The water utilisation plan is being designed by the Federation of the WMWUAs. The total cost of the pilot scheme is estimated to Rs. 30.54 lakh at the current prices of 2010. The benefit and cost ratio worked out for the project is 1.92, (measured on the current prices of 2009-10 and CSR of Maharashtra Jeevan Pradhikan, Pune Region) which is more than one indicating that the scheme is economically feasible. The land area with varieties of soil qualities is suitable for high value crops like horticulture crops, medicinal crops and forest products. Water is required during the summer. The shortage of water occurs from March to June. Therefore, only Kharif and Rabbi Crops are cultivated. About 1/3 amount of the land can be reserved for perennial irrigation crops, if drip irrigation system is implemented. This is being operated and determined by the WUAs.

Water distribution

Lift and drip will be the only mode of the distribution of irrigation water resources. Water distribution model is designed by the Federation of WUAs. The total land area of the five villages considered for the distribution of water (1100 hectares). It means total water allotted to this land area would be around 56, 68,000 cubic metres of irrigation water. Drip irrigation is obligated for equitable water distribution. This method of irrigation helps to equilibrate the demand and supply of irrigation water. It is designed as a multipurpose system suitable for all crops, whereby the cost of the drip system is higher initially, but it is cheap in the long run as the farmers can get flexibility in crop cultivation of their choice. They are and will be constantly educated in the cultivation techniques.

The first phase of water distribution consists of allotting quota of water to each village on the basis of population of the villages at the rate of 800 cubic metres per resident. The second and third phases consist of water distribution at the block and valve levels, which will be done by automation through computer programming.

Private pump sets

All cultivable land area of six villages is the operational area of the pilot project. There is however, some private lift irrigation schemes operated and managed by individual farmers prior to starting of the irrigation project. The areas they irrigate, mostly belongs to the nearby cultivable lands from the river bed. These farmers are also entitled to take the benefit of their share of water from the Chikotra Pilot Project subject to the contribution of their share amount. These farmers are free to receive the water from any sources (private or WUAs). The entrants in WUAs have to pay the necessary subscription fixed by the WUAs. For the convenience of the pilot project,

Table 3
First Phase of Water Distribution on the basis of population

Name of the villages	*Cultivable land area covered by WUA (in hectares)*	*Population of the village as per Census 1991*	*Water allocation under equitable distribution for each village (in cubic metres)*	*Water availability for WMWUA (in cubic metres)*
Belevadi-hubbalgi	240	1439	11,47,603	9,60,000
Bamane	246	985	7,85,538	5,48,000
Begavade	224	1083	8,63,693	8,00,000
Belevadi-kalamma	478	1557	12,41,708	8,00,000
Tamanakwadi	564	1912	15,24,820	
Dhamane	729	1753	13,98,017	
Total	2481	8729	69,61,379	

Notes: * Excluding irrigation under private lift schemes (around 250 hectares).

such land area under private pumps accounting to around 250 hectares is eliminated from the equitable water distribution model. However, to avoid, controversy, the irrigable command area demarcated and mapped under Chikotra Dam Medium Project is excluded from the total cultivable land area under the pilot project (The maps appended at the end indicate the second and third phases of water distribution in the six selected villages).

Even then, the private pump owners can be accommodated for conversion of their irrigated land to drip system, even if their land area may be more than 2.5 acres. They will be given the benefit of the Express Feeder Electric Line which supplies electricity for 16 hours and is free of load shedding. They will get the benefit of operating their pumps by the computer systems at the filter stations of the WMWUA. They are also eligible to become members for their land outside the command area of the Chikotra Project.

Distributive justice by cropping pattern

When water is scarce, it ought to be used economically. Water is an economic commodity. It is a value adding commodity. Obviously, it has to be priced. When it is distributed equitably and judiciously, again it ought to be used for the perfect utilisation of water qualities. A farmer, who makes a waste of water, he/she should be penalised. When water is judiciously used for cultivation, its demand and supply should be matched properly. Farmers demand water for crop cultivation and the WUAs are expected to supply the water with equity and efficiency. The farming blocks and the water valve areas are formed for equal and efficient use of water. Each block is assigned a specific quantum of water supply, within which the farmers in a block are expected to use it efficiently. For the convenience of the farmers the cropping pattern is designed by the Federation for each block. However, every freedom is given to the group of farmers under one valve to select any one crop within the limit of water use up to 4000 cu. m per hectare.

In the year 2009 – 2010 the crop wise blocks were designed tentatively as under;

Name of the block	*Kharif season*	*Rabbi season*	*Summer season*
Sugarcane	Overlap cane, Ratoon cane, and New plantation. (*Adsali* and *Suru*) approximately 110 ha.	Overlapcane, Ratoon cane approximately 110	Ratoon cane approximately 110 ha. hactares,
Cereals And Pulses	Paddy, Jowar, Bajara, Maize, Tur, Mung, Peas Groundnut and other approximately 110 ha.	Wheat, Jowar, Groundnut, Gram, other Pulsesetc approximately 110 hectares.	Fodder, Jowar, Groundnut, Mung etc. approximately 110 ha.
Horticulture block	Fruits and vegetables Approximately 1097 hectares	Fruits and vegetables approximately 1097 hectares	Fruits and vegetables approximately 1097 hectares
Fodder Block	Fodder Appx. 100 hectares.	Fodder Appx. 100 hectares	Fodder Appx. 100 hectares
Total (in hectares)*	1417	1417	1307

Note: * Excluding the area under private pump sets (approximately around 250 hectares).

The sugarcane belt is located at the nearby land areas of the river banks, which contains the alluvial soils suitable for sugarcane crop with high yielding rate. This area has been mostly occupied by the private irrigation pumps, as it is cost effective to the private pump holders. The private pump holders supply their surplus irrigation water on the share cropping (1/4 cane yield as water charges) basis to the neighbouring farm holders.

There shall be various types of crops grown with overlapping choices in each block of 50 acres. Each block is entitled to receive 80,000 cubic metres (50 acres x 1600 cubic metre of water) of irrigation water. The Federation and WUAs decide the season wise cropping pattern for all the six villages as a whole.

Division of the Project Area

The Federation has worked out a scientific area wise distribution of the cropping pattern in the project area. The cultivable land area has been classified into three groups of slopes and heights, viz; First Strip, Second Strip and Third Strip.

a) First stripe - The land area with less than 25 metres of height from river bedfalls under the first category; of which 50 per cent is reserved for one perennial irrigated crop i.e. Sugarcane, bananas etc.and 25 per cent area is reserved for two seasonal cash crops and one food crop and remaining 25 per cent for one cash crop and another food crop.

b) Second stripe - The uplands at 25 to 75 metres of height are reserved for four classified groups of crops. The first 30 per cent of land area is reserved for horticultural fruit crops covering guava, drumstick, and custeredapple to be planted at the 10 feets of distance. The next 30 per cent of land area is reserved for sugarcane. Thirdly, 20 per cent area is kept for seasonal three crops and remaining 20 per cent is reserved for two seasonal crops.

c) Third stripe - The plateau area at more than 75 metres of height and the hillycultivable plateau of Belevadi-kalamma. The water availability to such land is limited to 2000 cubic metres for a hectare of land area. The irrigation water allotted to one hectare (at the rate of 4000 cu.m per ha) is used for 2 hectares. Drip irrigation is mandatory on such land. The intercrops consisting of one Rabbi Food and one cash crop can be cultivated at the middle layers of the landscape. Only 20 per cent of top lands are proposed to be brought under irrigation during summer season. The nearby land areas of the river side are normally allotted for the cultivation of sugarcane and paddy. However, this pattern is not mandatory on the farmers. It becomes more complicated to the WUAs also.

d) Further the village wise cropping pattern differs due to the slopes of the landscape. The landscape of the village Belevadi-Hubbalgi differs from other villages. The cropping pattern assigned to the Belevadi hubbalgi village is as under;

   i) The land area at the first 25 metres of height covering 40 per cent of the total area is reserved for food crops, fodder and double crops. The next height from 25 to 75 metres covering 30 per cent of land area is reserved for sugarcane and other perennial irrigation crops. And the top lands at more than 75 metres of height covers the remaining 30 per cent land area, which is reserved for only horticulture crops.

   ii) In the village Begavade the total cultivable land area is to be irrigated. So, the cropping pattern remains as above. Drip irrigation for a block of 50 acres is feasible in this village. The upland (nearly 25 acres) of this village is feasible for construction of farm ponds.

   iii) Remaining villages will get the irrigation water to only 50 per cent of cultivable land area. Horticulture crops mainly include strawberry, vegetables, brinjals, potatoes, tomato, guava, jackfruit, custeredapple etc. Drip irrigation is compelled on the top of the hilly region, where the plantation horticulture crops are cultivated. The farm ponds are proposed to be built up at the feasible places on the top heights. Pond water can be used to the middle layer of the slope on gravity.

The land used for ponds can be compensated with proper justice to the land owners/holders.

e) Intercrops like mulberry, bamboo, medicinal plants, spices and other fruit crops can be planted in between the horticulture crops.

f) Sericulture, poultry, rearing the honey bees, and processing the forest products are the potential industrial activities in the basin.

g) Construction of farm ponds and land preparation for the plantation of horticulture crops can be taken up under Employment Guarantee Scheme. These are the subsidised activities in the State. Moreover, the funds from the Central Govt for these purposes are other incentives of plantation in the valley.

Distributive justice through block farming

Each 20 hectares or 50 acres of land area belongs to a block. The valve covers 1.60 to 4 hectares or 4 to 10 acres of land area. Each Block contains a water metre to measure the volume of water. At the valve level farmers are free to decide their cropping pattern depending on the water availability to them under equitable water distribution system. But they have to grow only one crop under one valve. The Table 4 below gives the height wise and strip wise cropping pattern and the volume of water available to each farm land.

The block and the land area on valves assigned to the each land area are estimated. The number of valves depends on the slope, land level and group of farmers. The valve area comprises from 1.60 to 4 hectares. The flow of water is assigned to each valve comprises of 17.4, 20 and 16.8 cubic metres. The time of water discharge assigned to each valve depends upon the crop grown under the valve. The rotation and time of watersupply to the valve will be controlled by the programming set in computers.

The cropping pattern is designed as per the slopes and topography of each village. Hilly slopes compel the farmers to go for intensive cultivation techniques. Sugarcane cultivation on the hilly slopes is not possible due to lack of motorable roads. Fodder and other short duration crops are recommended for cultivation at the terraces. Cash crops like strawberry, tea plantation, high value vegetables and fruit are possible in future.

Allotment of irrigated land from 1 acre to 2.5 acres has begun now in 4 of the 6 villages and it is likely to be completed by October 2013. A final decision on cropping pattern will be taken then by the WMWUAs and the Federation in their general body meetings under expert advice. This pattern will be implemented as soon the pipelines and pumping erection work is complete by March 2014.

Distributive justice in land and water allocation

1. The water distribution mechanism under the STEWD model confesses that, all farmers will get irrigation water up to 2.5 acres grossly. The land holders more than this limit, if they would allot their additional lands on contract or share cropping basis to the landless and marginal farmers in the same village for a period of at least 3 to 6 years, then these farmers will be eligible to irrigate more land up to a limit of 5 acres of land area subject to the availability of project land. Allotment of water for irrigating land more than 2.5 acre depends upon the surplus water available after allotment to land holders, labourers, marginal farmers and deserted women. The surplus water will be distributed equally to all medium and large farmers who demand more water. The criterion of water distribution is not based on the land area they hold, but how much they irrigate is the main principle of the justice in this case.
2. Every landless woman agricultural worker in the village can get for her survival at least 10 *gunthas* of land area on contract basis and 400 cu.m. of water as her right.
3. The land holders (normally the agricultural workers) below half acre can also claim additional land (another half-acre or more) from the WUAs under share cropping or on rental basis with a limit of at least one acre of total irrigated land area. So, mere totaling of area is not significant, but the total irrigated area (to the tune of one acre and 1600 cu.m. of water) is the right of every farmer family in the village.
4. The land holders, who are settled in cities for their services or business can also lend their land to the landless workers through WUAs on contract basis or share cropping basis.
5. If the irrigation water remains surplus with the WUAs after allocating the land and water to the villagers, the land holders of more than 2.5 acres can claim additional water for their lands from the WUAs, which will be again allotted equally.

Distributive justice in irrigation water

1. In a village there are 2 or 3 places on the river bank near a K.T. Weir from where water can be lifted. For a village Begavade, water can be lifted from the reservoir of Chikotra project. The pumps can be installed at one place on the dam itself. Water from this lift scheme can be supplied to the blocks of around 50 acres each.
2. There will be a water metre placed for each block located in the central filter house of the lift, which will be fully automised and the whole supply of water can be controlled by the computer programming at the filter house.

3. Lift and drip for the block of 50 acres is the basis of water distribution. The cluster of farmers falling under every valve shall be the beneficiaries of water distribution.
4. Each block can have a Supervisory Committee of five members to look after the mode and methods of water distribution and to encourage the groups of farmers under different valves to maximise their agricultural production in a competitive spirit.
5. There shall be one water discharging valve for every 4 to 8 acres. The valve command can be having one and the same crop at a given time (season).

Supporting services

Dependency on agriculture and poverty is enduring in the river basin. Progress can only be achieved through rational use of water and land resources. This project does not consider CUD (conservation, utilisation and distribution) of water resources only, but the allied activities of the agriculture are also preferably considered for the overall welfare of the farm community. Agricultural processing, marketing and agribusiness models are being developed on the basis of the local experiences. The Commodity and Marketing Federations and Unions of such activities are already registered and established. The output processing, marketing and agribusiness activities will further develop the employment opportunities in the farm and off farm activities. This will be a replicable model for other villages in the basin and even other watersheds and basins too.

Outcome of the equitable water distribution model

Following outcomes are earmarked;

1. The prominence of the model lies in providing water rights, equity, justice and the significance of collective rationality in the rural area.
2. It provides appropriate scope for introducing contract farming, nutrifarm, precision farming, organic farming, corporate farming etc.
3. The gaps in the existing demand and supply of irrigation water can be minimised with an increase in the crop productivity. The productivity of sugarcane can be increased from current average of 30 tons per acre to forecasted 60 - 70 tons per acre.
4. There is no commercial plantation of horticulture crops at present. The model will provide sufficient opportunities to go for high value plantation crops like; strawberry, guava, cashew nut, vegetables crops like brinjals, green vegetables, tea plantation, forest crops, fodder crops etc.

5. High value crops can be cultivated and group marketed in the nearby and faraway markets collectively and cooperatively. The institutional linkages are built up by the WUAs.
6. The traditional food crops can be replaced by modern high valued and high yielding cereals and pulses.
7. The supporting and allied activities like dairy, poultry, aquaculture, bee keeping and fodder processing rice mills will increase.
8. The farm and off farm activities will attract employment opportunities in the region.
9. Growth of services sector, processing sector and the marketing links can be created through the model.
11. The cost effectiveness by way of saving the fertilizer costs, proper use of thediversified climatic change will revolutionize the public outlook.
12. The cost of new cultivation will increase but along with increase in yield andcrop quality.
13. Horizontal and vertical institutional network can be developed with effectivelinkages in the area.

CONCLUSIONS

The Chikotra River Basin is one of the replicable models, which can be taken up as one of the fair and judicious system of water distribution and water allocation. It considers the ecological and environmental needs of the basin. There is Rawlsian fairness in the system alongwith equity, social and economic justice in its operations. Irrigation water is held responsible in eliciting all types of fairness and justice in the rural society. This is, in fact, the gift of the model to the economic literature. But the change in local mindset is utmost necessary. The politics of water should not mar the very purpose of the project. If the other villages converge on the same line there shall be a unique model for the cluster of villages of the world. It will be a replicable model for the world in general and Indian in particular. The educational institutions like the universities should be the knowledge partners in such type of river basins. Desirable transformation is possible when the deployment of rich resources like land and water are resolute of knowledgably rich farmers. On the occasion of G2R, let us hope such type of replica.

References

Anderson, T. and Synder P.S. (1997b), *Water Markets: Priming the Invisible Pump,* Cato Institute, Washington, D.C.

Bandaragoda, D.J. (1998), *Design and Practice of Water Allocation Rules: Lessons from Warabandi in Pakistan's Punjab,* IIMI, Research Report, 17, Colombo, Sri Lanka.

Biswas A. K. (ed.) *Water Resources: Environmental Planning, Management andDevelopment,* McGraw-Hill, New York.

Colby, B. (1989), Estimating the Value of Water in Alternative Uses, *Natural ResourcesJournal,* 29: 511-527.

Dudley, Norman and Bradley Scott, (1997), Deriving Short-Run Multistage Demand Curves and Simulating Market Prices for Reservoir Water Under Weather Uncertainty, in Parker and Tsur (Eds.) *Decentralization and Coordination of Water ResourceManagement,* Kluwer Academic Publishers, Boston.

Dinar, A. and D. Zilberman (eds.) (1991), *The Economics and Management of Water andDrainage in Agriculture,* New York, Kluwer Academic Publishers.

Dinar, A. and J. Letey, (1996), *Modeling Economic Management and Policy Issues ofWater in Irrigated Agriculture,* Praeger, London.

Dinar, A., M.W. Rosegrant, and R. Meinzen-Dick. (1997), Water Allocation Mechanisms: Principles and Examples, World Bank: Policy Research Working Paper, 1779, Washington, D.C.

Dinar, A. (ed.) (2000), *The Political Economy of Water Pricing Reforms,* Oxford 49 University Press (forthcoming).

Easter, K.W. and Welsch D.E. (1986a), Priorities for Irrigation Planning and Investment, in K.W. Easter (Ed.) *Irrigation Investment, Technology, and Management Strategies forDevelopment,* Westview Press, Boulder.

Easter, K.W. and Welsch D.E. (1986b), Implementing Irrigation Projects: Operational and Institutional Problems, in K.W. Easter (Ed.) *Irrigation Investment, Technology, andManagement Strategies for Development,* Westview Press, Boulder.

Easter, K.W. (1987), Inadequate Management and Declining Infrastructure: The Critical Recurring Cost Problem Facing Irrigation in Asia, *Institute of Agriculture, Forestry andHome Economics,* University of Minnesota, Economics Report ER87-2.

Easter, K.W. (1993), Economic Failures Plagues Developing Countries' Public Irrigation: An Assurance Problem, *Water Resources Research,* 29(7): 1913-1922.

Gibbons, D. (1986), *The Economic Value of Water,* Resources For the Future, Washington, DC.

Griffen, R.C. and G.M. Perry, (1985), "Volumetric Pricing of Agricultural Water Supplies: A Case Study," *Water Resources Research,* 21(7): 944-950.

Government of Maharashtra, (2009), Report on Benchmarking of Irrigation Projects in Maharashtra, State, Water *Resources Department*, Government of Maharashtra.

Government of Maharashtra, (2008), Sinchan Sthithi Darshak Ahval (Marathi), Irrigation Department, Government of Maharashtra, Mumbai.

Government of Maharashtra, (2010), Karyakram Andaj Patrak, *Government Press*, Irrigation Department, Nagpur.

Government of Maharashtra, (2009), Report on Water Auditing on Irrigation Projects in Maharashtra State 2007-08, *Water Resource Department, Government of Maharashtra*, Aurangabad.

Govt. of Maharashtra,(2008), Approach Paper On Developing Regulations for BulkWater Pricing in the State of Maharashtra.

Jean, M. (2001), Conference Proceedings. Sintra, 6-7 Sept 1999, in P*ricing water,Economics, Environment and Society*, ISBN 92-894-0681-X, pp. 141-147.

Johnson, S. H. (1997), Irrigation Management Transfer: Decentralizing Public Irrigation in Mexico, *Water International,* 22(3): 159-167.

Johnson, S.H., M. Svendsen, and X. Zhang, (1998), Changes in System Performance in Two Chinese Irrigation Systems as a Result of Organizational Reform, *Irrigation andDrainage Systems,* 12: 289-309.

Johansson Robert C. (2000), Pricing Irrigation Water: A Literature Review, policy Research Working Paper 2449, The World Bank, Rural Development Department, September.

Jugale V. B. (2010), Water Pricing in a Competitive Water Markets (Maharashtra), *Arthsanad*, September-December (Marathi).

Jugale V. B. (2015), *Irrigation Water pricing*, Serials Publications, New Delhi.

Just R. E., Hueth D. L. and Schmitz A. (1982), *Applied Welfare Economics and PublicPolicy*, Hall, Englewood Cliffs, NJ.

Perry, C.J. and Narayanamurthy S.G. (1998), *Farmer Response to Rationed andUncertain Irrigation Supplies,* IIMI, Research Report, 24, Colombo, Sri Lanka.

Rhodes, G.F., and Sampath R.K. (1988), Efficiency, Equity and Cost Recovery Implications of Water Pricing and Allocation Schemes in Developing Countries, *Canadian Journal of Agricultural Economics,* 36: 103-117.

Rogers, P. (1992), Comprehensive Water Resources Management: A Concept Paper, World Bank Working Paper Series 879, Washington, D.C.

Sampath, R.K. (1983), Returns to Public Irrigation Development, *American Journal ofAgricultural Economics, 65(2):* 337:339. 59.

Sampath, R.K., (1990a), On some aspects of Irrigation Distribution in India, *LandEconomics,* 66: 448-463.

Sampath, R.K., (1990b), Young R. (eds.) *Social, Economic and Institutional Issues in Third World Irrigation Management,* Westview Press, Boulder, CO, 75-108.

Sampath, R.K., (1991), "A Rawlsian Evaluation of Irrigation Distribution in India," *Water Resources Bulletin,* 27: 745-751.

Sampath, R.K., (1992), Issues in Irrigation Pricing in Developing Countries, *WorldDevelopment,* 20: 967-977.

Small, L.E. and Carruthers I. (1991), *Farmer Financed Irrigation: The Economics ofReform,* Cambridge University Press, Cambridge.

Small, L.E. and A. Rimal, (1996), Effects of Alternative Water Distribution Rules on Irrigation System Performance: A Simulation Analysis, *Irrigation & Drainage Systems,* 10: 25-45.

Svendsen Mark, (2005), Irrigation and River Basin Management: Options for Governance and Institutions, *CABI Publishing, Cambridge, USA*

Svendsen, M. and Nott G. (1997), *Irrigation Management Transfer in Turkey: EarlyExperience with a National Program under Rapid Implementation,* IIMI, Report, 17,Colombo, Sri Lanka.

Spulber, N. and Sabbaghi A. (1998), *Economics of Water Resource: From Regulation toPrivatization.* Kluwer Academic Publishers, Boston.

Tsur, Y. and Dinar A., (1995), Efficiency and Equity Considerations in Pricing and Allocating Irrigation Water, World Bank Policy Research Paper, 1460, Washington, D.C.

Vaux, H.J. and Pruitt W.O. (1983), Crop-water Production Functions, *Advances inIrrigation, 2:* 61-97.

Vaux, H. J. and Howitt R.E. (1984), Managing Water Scarcity: An Evaluation of Inter-regional Transfers, *Water Resources Research,* 20: 785-792.

WALMI (1992a), *Water Distribution Practices in Maharashtra State*.

WALMI (1992b), *Operation and Management of Irrigation System in Maharashtra State.*