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**Hobbes, Coase and Baliraja:
Equity and Equality in Surface Water Distribution**

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Abstract

Natural resource management may be perceived as a search for institutions that can ensure simultaneous fulfillment of three goals: productivity (or efficiency), sustainability and equity. In this paper we study the implications of pursuing the goal of equity in the management of surface water resources for irrigation. We do so with an abstract analysis using Leontief-type fixed production function.

One suggestion is that allocating tradable water rights over water, a common property natural resource, can be used as an instrument to improve equity. Unfortunately, advocating the use of water distribution as an instrument of poverty alleviation is fraught with implicit assumptions of the rural economy and uncertain outcomes. It is also important for planners to understand that the concepts of equity and equality are applicable to inputs and outputs or outcomes. In this paper we attempt to understand the implications of equality in water distribution on social welfare with a simple abstract analysis. The theoretical analysis shows the possible outcomes of such a policy and is also intended to raise pertinent questions and hypotheses in studying the effectiveness of irrigation and watershed initiatives where rights over water have been redistributed equally. It is not intended to be a criticism of such initiatives.

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Hobbes, Coase and Baliraja: Equity and Equality in Surface Water Distribution

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1 Introduction and Objectives

Natural resource management may be perceived as a search for institutions that can ensure simultaneous fulfillment of three goals: productivity (or efficiency), sustainability and equity¹. In this paper we study the implications of pursuing the goal of equity and equality in the management of surface water resources for irrigation. We do so with an abstract analysis using a Leontief-type fixed production function.

Achieving equity through poverty alleviation of the core-poor has become an important objective of watershed development projects initiated by the government, international agencies and/or non-governmental organizations (NGOs). A clear indication of this can be found in the project report of the World Bank assisted Karnataka Community-Based Tank Management Project (World Bank 2002), which states:

“ ... people such as women, tribals, landless and low-caste groups often remain marginalized in local decision-making. The project will therefore establish organizational structures and norms which legitimize and support the inclusion of these groups in decision-making and benefit distribution” (pg. 23).

In India, there are almost 300 million rural poor, 70% of them being marginal farmers and landless agricultural laborers. As much as 80% of usable water resources go to irrigation (Rao 2002) disproportionately benefiting the landed peasantry. Within the irrigation sector, Phadke (2002) mentions that only about 2% of farmers in one Indian state (Maharashtra) use about 70% of the irrigation water. With the core-poor bias becoming mandatory in development initiatives, watershed projects are required to look for strategies that will *more directly*

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¹ Equity in what? Distribution of resources or outcomes? We will return to this question later in the paper.

enhance the benefits accruing to this segment of the rural population. One suggestion is that water must be seen as a common property resource and allocating tradable water rights over water to each and every individual, and not just the landed peasantry, can be an instrument to improve equity (Rosegrant and Binswanger 1994). In India, the Baliraja Memorial Dam project is a case in point where tradable rights over surface water distribution were proposed as a means to alleviate inequities in the distribution of income and wealth.

Several questions need to be raised in response to any such proposal:

- Who must get rights over the use of water?
- On what basis do these persons or groups claim their right over the water?
- How do excluded groups including the poor get rights from the present landed elite controlling the resource?
- What is the nature of rights that can be assigned to landless and marginalized people?
- Who decides, negotiates and assigns rights over water? (Meinzen-Dick and Bruns 2000).

While focusing our attention on these questions we may overlook a larger question as to whether distribution of water² should *at all* be used as an instrument to achieve a society's distributional or equity-related goals. Water (except drinking water) is an input or factor of production in agriculture and other rural activities. Equity in water distribution then cannot be an end in itself; its distribution must be seen as having a significant effect on distribution of outcomes or output. But can we not achieve distributional goals through direct taxation and redistribution of output or income? What are the implications of each method on efficiency (or productivity) and sustainability?

One reason why water distribution may be considered an instrument of poverty alleviation is that taxation perhaps, is not an instrument available to NGOs or local governmental bodies like the *panchayat*. Even the government is constrained by social and political factors in introducing taxation on agricultural incomes. With such constraints over redistribution of output, development organizations must turn to key inputs like land and water. With movements for land reform reaching a dead-end, distribution of water is acquiring greater

² “Distribution of water” here implies “distribution of water rights”. These phrases are used interchangeably throughout this paper.

importance as a "second best solution" (Lipsey and Lancaster 1956) in achieving distributional objectives of watershed projects.

Unfortunately, advocating the use of water distribution as an instrument of poverty alleviation is fraught with implicit assumptions of the rural economy and uncertain outcomes. This paper studies the complexities that arise from an allocation of water rights and provides guidelines for socio-economic planning and policy in watershed projects. It leads us to the conclusion that an equal sharing of water with tradable water rights need not automatically be a "second-best solution" to direct taxation of output.

2 *Conceptualizing Equity and Equality*

Any notion of social welfare must be based on a clear articulation of two concepts, equity and equality. Not only do we need to conceptualize these terms but also understand how they relate to inputs and outputs.

Following Murray-Rust *et al* (2000) we conceptualize equity as a concept based on a principle of fairness: a distribution of a whole into parts that is acceptable to all members of a community, which need not be equal. Equity is contextualized within existing social values, it is a *subjective* or *qualitative* term, and what is acceptable to one community need not be acceptable to another, or even to the same community over a period of time with changes in its social and economic structure.

For instance, in an equitable water distribution system some people may get a larger share of water due to prior rights, in compensation for greater contribution of system construction and maintenance (Murray-Rust *et al* 2000). Interesting examples of equity in traditional systems are also found in Agarwal and Narain (1997): for instance, the *Kul* system in Himachal Pradesh where in years of scarcity the big landowners get access to water first and small farmers get access to water only later during the season. The community, however, found the system equitable because the demand for labour is spaced over two phases; this allows small peasants to work on the landlords fields in the first phase and then their own later. Moreover, no labour shortages occur and wages remain stable throughout the cropping cycle.

Equality, on the other hand, is an *objective* or *quantitative* term and is taken to mean equal shares of the whole related to “a directly measurable parameter” (Murray-Rust *et al* 2000, pg. 1). In the context of water distribution, this measurable parameter can be size of landholding (proportionate equality) or the individual; in the latter case, every member of the society irrespective of landholding, gender and/or occupation gets an equal³ share of water. Non-traditional systems, like those promoted by new social movements and NGOs, usually look for equality in water distribution, rather than equity.

Equal sharing of water need not mean that it is equitable. The principle of proportionate equality is one example (Chambers 1984). But even when the *individual*, and not land, is the chosen parameter, equality need not imply equity. For the sake of argument, consider two couples A and B. Family-A is progressive and has one girl child. They decide not to have any more children. Family-B, on the other hand, being biased against girl children, ends up with 4 girls and finally a boy before they decide not to have any more children. With an “equal” distribution of water family-A is allocated 3 units of water whereas family-B gets 7⁴ units. Is this “equitable” or “fair” to family A?

We have also seen systems that are considered equitable even though water is not shared equally (the example of the *Kul* above). We can, therefore, state that equality does not imply equity or *vice versa*⁵.

It is also important to understand that the concepts of equity and equality are applicable to both:

- Inputs, resources or opportunities.
- Output or outcomes.

³ Our analysis holds good for any redistribution of rights over water, even if it is not perfectly "equal". What is important is that water rights are not related to landholding so that even the landless are assigned a share of water resources. Hereafter, equal distribution must be understood in this sense.

⁴ Each member of the family gets 1 unit.

⁵ We speak here of equity and equality in water distribution. But the issue is a larger one and encompasses many social and economic subjects. Arguments for and against reservation on the basis of caste and religion often confuse equality from equity.

The distribution of inputs according to the principles of equity or equality can neither take for granted nor ignore their effect on the distribution of output. More often than not watershed projects are clear on their objectives regarding equality or equity in input distribution without realizing the full implications of such policies on output or outcomes. Social welfare, however, ultimately depends on the distribution of outcomes, whether equitable or equal.

In Table 1 we construct a 3 x 3 matrix of possible input-output combinations. Not only have we situated the liberal and socialist doctrines but also the pure market system and “traditional systems”. Acocella (1998) categorizes the liberal doctrine as one where opportunities are equal but outcomes are determined by personal ability, which will be unequal (but equitable). The socialist doctrine (from each according to his/her ability to pay to each according to need) is based on the efficiency in the use of inputs and equal distribution of output, under a central plan. A market system that ignores the initial distribution of resources results in an outcome that is both, unequal *and* inequitable, (box C-Z). We have shown traditional systems, for instance a feudal society, in both, boxes A-X and A-Z, because distribution of output can be considered as equitable (though unequal) by those within a community but inequitable (*and* unequal) by those on the outside.

Table 1: A Matrix of Possible Combinations of Input and Outcomes

		Outcomes		
		Unequal but Equitable (X)	Equal (Y)	Unequal and Inequitable (Z)
Inputs	Unequal but Equitable (A)	Traditional System as perceived by members within the community (A – X)	(A – Y)	Traditional System as perceived by people outside the community (A – Z)
	Equal (B)	Liberal Doctrine (B – X)	(B – Y)	(B – Z)
	Unequal and Inequitable (C)	(C – X)	Socialist Doctrine (C – Y)	Pure Market System (C – Z)

The objectives of watershed projects could be situated in this matrix. An active pro-poor policy in these projects means that outcomes must be in columns X or Y.

When water is considered an instrument to achieve social justice, equity or equality in its distribution restricts planners to rows A or B. In this paper we focus on a specific initiative: allocating an equal share of water (row B) to every individual and understanding its effect on outcomes. We, therefore, envision the outcome in box B-X or B-Y. As we will see, such “simple” policies *may*, though not necessarily⁶, result in an inequitable (with the poor worse off) and unequal outcome, i.e., box B-Z.

If allocation of water on an equal basis succeeds in bringing equity or equality in income distribution, then other projects need to consider this as an important policy option. If it fails in meeting its pro-poor objective, we need to know why and must explore other options. One possibility is row A – a return to traditional “equitable” systems – but with a realization that distribution of output may be inequitable, especially with non-traditional (or non-feudal) criteria of social justice. If such solutions are unacceptable the only option would be row-C; in particular box C-Y, with a redistribution of output through direct taxation.

3 Equality and Social Welfare in Water Distribution

Distribution of water rights for irrigation purposes in India has been based upon either of the two doctrines (Chambers 1984):

1. *Prior appropriation*: whoever first exploits a resource has the right to continue to do so. Inequality comes through usage since head-enders get customary right over water usage and tail-enders get less or no water.
2. *Proportionate equality*: water is supplied in proportion to land surface area. In this case the landless get no right over water. Inequality comes through land ownership.

As seen above, both these doctrines may be considered as inequitable (Chambers 1984) and have led to experiments where *people* have been made the basis for distribution of water rights. Rights over water are distributed equally to every household on the basis of number of members in each family, *irrespective of land ownership or location*. Some initiatives in India include: Sukhomajri in Haryana

⁶ This is the *raison d’etre* for our case study of the Baliraja watershed project.

(Chambers 1984, Kerr 2002), Gram Gourav Prathistan (more popularly, Pani Panchayat) in Maharashtra (Chambers 1984, Shah 1993, Kerr 2002), the Aga Khan Project in Gujarat (Shah 1993) and Ramnathapuram in Tamil Nadu (Shah *et al* 2002). Such schemes have found general support from economists and activists.

Shah (1993), for instance, articulates the objective of distributing water equally amongst households as follows:

"In our search for social justice and for ways to reduce rural economic inequalities, land reforms have all but lost their relevance. But a more equitable distribution of water rights may still provide a major opportunity" (pg. 15).

"Equal shares (of resources) could produce distributive effects similar to a powerful land reform" (pg. 7).

Kerr (2002) in his recent work on watershed development in India has made a similar argument:

"The last few years have seen a growing concern about ensuring that poor, landless people benefit from watershed development ... return to the ideas first introduced in the Sukhomajri and Pani Panchayat projects calling for poor people to gain usufruct rights to natural resources made more plentiful or more productive through watershed development" (pg. 1391).

In fact, there is an implicit argument in Kerr's paper that equal share of water to every household is *superior* to others like granting of fishing rights or sharing products of common lands with landless people. The latter, he argues,

"... while favorable toward poverty alleviation, pale in comparison with the full and equal water rights granted to landless households in *Sukhomajri* and under *Pani Panchayat*" (pg. 1391).

Claude Alvares, referring to the Pani Panchayat project, also favours such equal sharing of water:

"It (equal sharing of water) gave the landless an economic (and, therefore, bargaining) power that had always been denied to them because they did not own land" (pg. 3)

“Several of the principles behind the organization of the Pani Panchayat ought to be made part of public policy. First, the principle that people should have equal shares in common resources, if adopted, would revolutionize society in far-reaching ways” (pg.8).

The Pani Panchayat allocated water shares equally, allowing the landless members of the water cooperative to lease lands. However, it did not allow the landless poor pecuniary exchange of their water shares (Phadke 2002). One scheme that went beyond mere water sharing was the Baliraja Dam project. Not only was water shared on a per individual basis, but members were entitled to shares that could be **traded**. Landless members could, therefore, sell their shares to others or use their share of water by leasing land from others (Phadke 2002). The idea is clear: an equal distribution of resources (or inputs) would reduce disparities in income (or output). In other words, allocating private property rights over resources like water can be used as a tool to achieve a “better” distribution in income. However, it is not clear whether “better” distribution in output implies equity or equality in output distribution.

4 *The Baliraja Experience*

The Baliraja movement⁷ in the 1980s was the effort of the *Mukti Sangharsh*, a people’s democratic struggle against powerful sand miners. The movement acquired rights for sand mining from the state and utilized it for construction of the 4.5 meter high Baliraja Memorial Dam. In line with its philosophy, the movement advocated two important objectives in the distribution of surface water resources from the dam. First, it addressed the question of sustainability. It was decided that in the drought-prone region where the dam was located it was important to move farmers away from cultivation of water intensive crops like sugarcane. This could be achieved through its second objective, equity. After the

⁷ Here we have not traced the interesting history of the Baliraja movement. This can be found in Joy and Rao (1998), Phadke (2002), and Jyotishi and Rout (2005).

construction of the dam, the movement implemented a project for the *equal sharing of water* amongst all households, including the landless, in the two villages of Tendulwadi and Balwadi. The landless or marginal farmers could either sell their share of surplus water or rent-in land for cultivation on a sharecropping basis. A price reflecting scarcity of water resources would facilitate the movement meet its twin objectives of equity and sustainability, simultaneously.

The Baliraja experiment serves as an anecdotal case or a background against which we carry out an abstract analysis on the implications of equal sharing of surface water on social welfare. It is important to emphasize that this paper is not an evaluation of the Baliraja or any other specific experiment.

5 Social Justice through Reshuffling Property Rights: The Economist's Concern

Even if we agree to redistributive goals (and it is here that economists tend to disagree), there is still the question as to how best these goals can be achieved; namely, about the *means* of achieving social justice. For several reasons⁸, economists believe that redistribution of wealth is better achieved through progressive taxation of output or income rather than through reshuffling property rights over resources or factors of production. However, as we discussed above, there are those who contend that redistributing access over inputs (like water) could bring about a greater degree of equality in outcomes.

Deciding on the means to achieve social justice cannot ignore the effects of these methods on efficiency or productivity. Let us for a moment consider the second scenario, i.e., where we redistribute rights over resources. The question then arises as to how such rights should be distributed? The **Coase Theorem** provides some assistance. It argues that the use of resources will be efficient regardless of the legal rule defining the allocation of property rights over these resources subject to the condition that there is successful private (but accommodating or cooperative) bargaining and transaction cost is zero or low enough for it not to inhibit bargaining. In real world situations, successful private bargaining cannot

⁸ These include transactions cost of redistributing an input or output and the distortionary effects of redistributing property rights. See Cooter and Ulen (1997).

be taken for granted. Not only are there transaction costs but several uncertainties and complexities pertaining to the particular resource in question and to the regional-sectorial context in which bargaining takes place.

This makes **Hobbes Theorem**⁹ relevant: the law should allocate property rights to the party who values it the most. By doing so the law makes exchange of rights unnecessary and saves cost of transactions (Cooter and Ulen 1997). Output is maximized and distributional goals can be achieved through direct taxation of output.

What do these arguments mean in the context of water distribution? On the basis of Coase's Theorem, assigning equal rights over water should lead to an efficient solution if private bargaining is efficient. If the costs of bargaining are too high or does not succeed for whatever reason, then Hobbes Theorem becomes more relevant. Equity could be more efficiently and effectively achieved through a progressive tax on output rather than distributing water rights equally.

Our concern here is not a simple equity-efficiency trade-off, but the possibility that allocation of property rights, without taking into account the complexities of private cooperative bargaining, could lead to a deterioration of social welfare based on the Hicks-Kaldor and even possibly by the Pareto criterion¹⁰. Such deterioration in social welfare will adversely affect the poorest of the poor; the purpose of equal water distribution initiatives will be self-defeating.

6 An Abstract Analysis of Equality in Water Distribution

In this section we attempt to understand the implications of equality in water distribution on social welfare. The analysis shows the theoretically possible outcomes of such a policy and is also intended to raise pertinent questions and hypothesis in studying the effectiveness of watershed initiatives where rights over water are redistributed equally.

⁹ To Hobbes humans carry the inherent drive to fight so that "only by imposing will upon the ruled can society be organized to run efficiently and peacefully" (Tidwell 1998), (pg.42.).

¹⁰ Hicks-Kaldor deterioration (improvement) in welfare: aggregate net benefit declines (increases).

Pareto deterioration (improvement) in welfare: nobody (at least one person) is better off and at least one person (nobody) is worse off.

Let us consider a *real* economy with two farmers, F_1 and F_2 producing an output Y using three inputs: land (L), labour (N) and water (W). Each farmer faces a Leontief-type fixed production function given by:

$$Y_i = \min(L_i, N_i, W_i), \quad i = F_1, F_2 \text{ (or 1,2)} \quad \text{(a)}$$

Let the initial endowments be given as:

$$\begin{array}{lll} L_1 = 90 & L_2 = 10 & \\ N_1 = 50 & N_2 = 50 & \\ W_1 = 90 & W_2 = 10 & \\ Y_1 = 50 & Y_2 = 10 & Y_{1+2} = 60. \end{array} \quad \text{(1)}$$

Clearly, this is a sub-optimal situation and there exists a possibility for cooperative bargaining between F_1 and F_2 . The optimal situation will be where:

$$\begin{array}{lll} L_1 = 90 & L_2 = 10 & \\ N_1 = 90 & N_2 = 10 & \\ W_1 = 90 & W_2 = 10 & \\ Y_1 = 90 & Y_2 = 10 & Y_{1+2} = 100. \end{array} \quad \text{(2)}$$

F_1 must pay F_2 a wage (a share of Y_1) for his labour services. The wage will be a result of the bargaining game between F_1 and F_2 . A “reasonable”¹¹ solution will give us a wage rate p_N : $40 < p_N < 0$. This exchange will mean an improvement in social welfare on the basis of both, the Hicks-Kaldor as well as Pareto criteria.

As pointed out by Cooter and Ulen (1997), a reasonable solution invokes social norms. In the context of rural labour markets, a reasonable solution would have to take into consideration not merely demand and supply but several complexities including class and caste structure, interlocked markets, availability of migrant labour and so on.

Starting from (2), consider now that water is equally redistributed amongst households in this village so that initial endowments of resources and output are:

¹¹ Cooter and Ulen (1997) distinguish between a rational and reasonable solution. A rational solution could be $p_N = 40 - e$ or $p_N = 0 + e$, where e is infinitesimally small. A rational wage is unlikely to be acceptable and a reasonable solution is more likely.

$$\begin{array}{lll}
L_1 = 90 & L_2 = 10 & \\
N_1 = 90 & N_2 = 10 & \\
W_1 = 50 & W_2 = 50 & (3) \\
Y_1 = 50 & Y_2 = 10 & Y_{1+2} = 60.
\end{array}$$

Once again, this is a sub-optimal situation and there exists a possibility for cooperative bargaining between F_1 and F_2 . One possible solution is where the distribution through exchange reverts to **(2)**.

F_1 must pay F_2 a price for F_2 's water share. The price of water will be a result of the bargaining game between F_1 and F_2 . A solution will give us a water-price, p_w : $40 < p_w < 0$. This exchange will mean an improvement in social welfare on the basis of both, the Hicks-Kaldor as well as Pareto criteria. Let us assume that a reasonable water-price is $p_w = 20$. This gives $Y_1 = 70$, $Y_2 = 30$ and $Y_{1+2} = 100$.

Corollary 1: a "reasonable" solution to the bargaining game depends on the existence of a water market.

Corollary 2: even if there exists an efficient water market, equal allocation of water by itself cannot bring about equality in income. However, income of F_2 does improve with the allocation of water rights though the extent of improvement depends on p_w .

Corollary 2 makes it clear that reaching box B-Y in Figure 1 through equal distribution of water is not feasible. A more likely outcome would be to reach box B-X, an "equitable" one with the degree of equity depending on p_w .

Returning to Corollary 1, let us delve further on the importance of water markets. Consider an initial resource endowment as:

$$\begin{array}{lll}
L_1 = 90 & L_2 = 10 & \\
N_1 = 50 & N_2 = 50 & \\
W_1 = 50 & W_2 = 50 & (4) \\
Y_1 = 50 & Y_2 = 10 & Y_{1+2} = 60.
\end{array}$$

One possible solution to maximize social output is an exchange of resources as in **(2)** above so that $Y_{1+2} = 100$. F_2 will get an amount $(p'_N + p'_w)$: $40 < (p'_N + p'_w) < 0$.

What happens if no water market exists or, in other words, F_1 and F_2 are unable to exchange their rights over water? We then have a situation where F_1 will not employ labour services and the situation remains as given by the initial endowments, i.e., as in (4) above with $Y_{1+2} = 60$. Both F_1 and F_2 are *worse off* than with unequal distribution of water as in (1) giving us:

Corollary 3: the non-existence of a water market may mean deterioration in social welfare under both, the Pareto as well as the Hicks-Kaldor criteria.

It is important that by the "non-existence" of water market we include lack of markets with reasonable transaction costs. The importance of transaction costs associated with the redistribution and exchange of water (T_W) must be understood prior to any arrangement redistributing water rights. T_W , as we have seen, will include not only costs of obtaining information on productivity of water but also legal and other negotiation costs. Moreover, physical and technical costs of storage, transport and measurement of water needs to be taken into consideration (Rosegrant and Binswanger 1994). Returning to the Coase Theorem, T_W is a key determinant as to whether sharing water equally will have its desired effect on equity. A strong institutional arrangement is an important prerequisite to keep T_W within reasonable limits (Rosegrant and Binswanger 1994).

Corollary 4: high transaction cost in cooperative bargaining in water markets could lead to loss in social welfare. Bargaining in labour markets is likely to have lower transaction costs.

Where transaction costs in trading water rights are too high, equal distribution of water may not be the advisable.

Corollary 5: given that labour markets exist, using the Hobbes Theorem and allocating water share according to land area (principle of proportionate equality) would mean that both F_1 and F_2 are better off¹².

Returning to (1), we saw that a reasonable solution would mean $p_N: 40 < p_N < 0$. With (4), if exchange of water and labour does take place, we must have $(p'_N + p'_W): 40 < (p'_N + p'_W) < 0$. A reasonable solution, as we have seen, invokes social complexities, which means one cannot assume that $(p'_N + p'_W) > p_N$.

¹² Both F_1 and F_2 are better off with a resource distribution given by (1) rather than by (5).

Corollary 6: a forced redistribution of water resources could have a negative impact on wage rates to compensate the landed elite for p_w .

This brings us to another important result. There can be no doubt that the ideal situation for both efficiency and equity is when endowments are given as:

$$\begin{array}{llll} L_1 = 50 & & L_2 = 50 & \\ N_1 = 50 & & N_2 = 50 & \\ W_1 = 50 & & W_2 = 50 & \\ Y_1 = 50 & & Y_2 = 50 & Y_{1+2} = 100. \end{array} \quad (5)$$

Corollary 7: when endowments are not equal in more than one market, correcting the imbalance in one market alone may not be the second best solution.

With initial endowments as in (4) above, another possible cooperative solution between F_1 and F_2 would be through a sharecropping¹³ agreement, where F_1 transfers 40 units of land to F_2 (or F_2 rents in land on a sharecropping basis). A reasonable solution, say a 50:50 sharecropping arrangement, would once again mean an improvement in F_2 's income although equality in income between F_1 and F_2 is not possible.

Corollary 8: the lack of water markets would mean that sharecropping¹⁴ is more likely to be the outcome of equal sharing of water.

Corollary 9: equal sharing of water may need a simultaneous application of the normative Coase Theorem (Cooter and Ulen 1997): Structure the law so as to remove impediments to private (sharecropping) agreements.

Essentially, we need to lower transaction costs - in the case of sharecropping this will mean assigning simple, clear and well-defined property rights to land.

¹³ We ignore the possibility of land sales, since sharecropping is the preferred option in most rural economies.

¹⁴ Most rural economies already have traditional (non-formal) rules for sharecropping arrangements, thereby keeping transaction costs low.

However, sharecropping may not be the final option, especially, where F_1 has access to alternative source of water. This alternative could be groundwater that can be used for irrigation by pumping it to the surface, instead of buying surface water from a reservoir.

Consider an initial distribution of resources as in (5) above. With no water market, cooperative bargaining would mean sharecropping at, say, $p_L = 20$ units of Y and $Y_{1+2} = 100$. However, if F_1 can obtain 40 units of water (groundwater) at a price (C_{GW}) then he would prefer to extract groundwater if:

$$C_{GW} + p_N < p_L. \quad (b)$$

In this case, F_2 is left with surplus water, which can neither be sold nor used on land made available on sharecropping basis.

Corollary 10: equal sharing of water need not automatically mean an improvement for the landless and marginal farmers.

Corollary 11: improving equity through sharing of inputs may require a restriction on exploitation of inputs from alternative sources; for instance, this alternative could be exploitation of groundwater.

The understanding of cooperative bargaining in land, labour and water markets will be incomplete without taking into account the market for a vital input, credit (R). Using the Leontief-type fixed production function with credit as an input, gives us:

$$Y_i = \min(L_i, N_i, W_i, R_i), \quad i = F_1, F_2 \quad (c)$$

Consider an initial resource distribution as:

$$\begin{array}{ll} L_1 = 90 & L_2 = 10 \\ N_1 = 50 & N_2 = 50 \\ W_1 = 90 & W_2 = 10 \\ R_1 = 100 & R_2 = 0 \\ Y_1 = 50 & Y_2 = 0 \quad Y_{1+2} = 50. \end{array} \quad (6)$$

The imperfect "endowment" of credit amongst F_1 and F_2 makes water redistribution a "useless" exercise. Access to credit is likely to landowners rather than water owners since water is unlikely to be considered collateral for loans. Two options are available to F_2 . The first is to sell his labor to F_1 at p_N : $0 < p_N < 40$. However, output is not maximized with $Y_{1+2} = 90$. F_2 may also decide to rent out his land to F_1 so that he receives $(p_N + p_L)$: $0 < (p_N + p_L) < 50$.

In fact, where C_{WG} is low and imperfect markets, like that for credit, exist we may even find "reverse sharecropping" from F_2 to F_1 .

Corollary 12: it may not be sufficient to merely lower T_w or develop technologies to distribute water rights to the landless poor and marginal peasants to bring about equity in output when imperfect markets like that for credit are taken into consideration.

Finally, we must return to the economist's contention that social justice may be better achieved through a progressive taxation than redistribution of property rights in water. Given that initial endowments as in (5) is unlikely, equal sharing of water could mean a loss in social welfare as per Corollaries 3, 4 and 10, so that:

Corollary 13: if the transaction cost of imposing a progressive tax on output $T_X < T_w$, then equity is better achieved with an income or output tax.

In India, agricultural income remains untaxed. Even then one cannot ignore the possibility of the landless and marginal farmer to actually be worse-off from a reduction in employment and wage income due to inefficient water and credit markets.

7 The Baliraja Experiment Revisited

In the late 1980s one of the authors had visited the Baliraja Dam Project. It was more than 15 years later that the present authors decided to revisit the project. The second author did. Some of his observations were reported in a paper (Jyotishi and Rout 2005). A further attempt to put what was observed on location into a theoretical framework was made. This paper is the outcome of that exercise.

We summarize the most important observation made on revisiting the Baliraja project. First, a number of large farmers were extracting groundwater using electric pumpsets to cultivate sugarcane, a highly water intensive crop. Second, in some cases, large farmers grew subsistence crops with their share of surface water from the Baliraja Dam, but cultivated sugarcane in remaining portions of their holdings using groundwater. Third, big farmers also leased land¹⁵ from marginal farmers on a 25% sharecropping basis and grew sugarcane using groundwater. The return to the marginal farmer from this 25% share was higher than that from growing subsistence crops. Moreover, without the need to cultivate their land, marginal farmers were able to work in sugar factories and earn decent wages. Last, there was no evidence that a water market had emerged in the Baliraja project area. The equal sharing of water seemed pointless in meeting its objective of bringing about equality in output distribution¹⁶. It is no wonder then that the Baliraja Dam project stands incomplete even today with the proposed timber gates never having being installed.

It is obvious that equal sharing of water makes good economics when members of the water cooperative have a fairly equal endowment of resources to begin with. To an extent, this could be one reason why the Pani Panchayat experiment was more successful. Members of the water council were mostly all marginalized farmers with small landholdings. Moreover, sale of water rights was not permitted and this meant that farmers were motivated to cultivate mainly less water intensive subsistence crops. More the “equality” (which already existed amongst the members of the cooperative), the question of food security was tackled effectively.

When differences in land endowments are significant, equal sharing of water will not result in equity or equality in output. But even when land (re)distribution may be forced upon members of a collective, the distributional objectives of a water sharing project may be far from being realized. An interesting example is the Andhi Khola Irrigation Scheme in Nepal (van Etten *et al* 2002) where delays,

¹⁵ This is what we termed as “reverse sharecropping” above.

¹⁶ As mentioned above, the Baliraja experiment also aimed at achieving *sustainability* in one of India’s most drought prone regions, by inducing farmers to take on subsistence crops instead of sugarcane. This, however, does not seem to have taken place to any significant scale.

transfer of poor quality lands and transfer charges that had to be borne by the landless all combined to dilute the objective of the project.

“The most opportune moment for the land transfer, well before construction, was lost. This rendered the land price for the poor high and it benefited larger farmers willing to sell. Inequalities remained substantive” (pg. 18).

The rooted complexities of the rural economy cannot be assumed away; in fact, they render any simplistic idea of redistributing wealth and income through redistribution of property rights over inputs like equal water shares completely ineffective.

van Etten *et al* (2002) make a similar observation:

“Another option to ensure less unequal benefits for the poor is by allocating water rights equally among all landowners, tenants and landless people. In these cases, water is not only used to irrigate own plots but also for exchange and sale, which opens up new possibilities for those with little or no land. This allocation principle of “water to the people” is claimed to be more pro-poor than the common principle of “water to the land” by which water is allocated to landowners in the command area, proportional to their land size ... there is little or no empirical evidence to show whether this option of allocating equal water rights does actually benefit the poor” (pg. 1).

This leads us to the conclusion that a more in-depth understanding of the rural economy is important before adopting simplistic solutions to achieve equity or equality in income and wealth. The corollaries derived from our abstract analysis provide useful guidelines that need to be examined in drawing up policies that achieve redistribution goals.

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¹⁷ No date mentioned

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