GENDER AND POVERTY DIMENSIONS OF IRRIGATION TECHNIQUES FOR TECHNICAL PEOPLE

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Abstract

Identifying technology users and finding effective ways to reach them is intrinsic part of the profession of irrigation engineers and technical people. The user-oriented questions 'who is the user' and 'how to reach him or her' are also a conduit to approach gender and poverty dimensions of irrigation in general and micro-irrigation in particular, as elaborated in this paper. First, key user groups of technology development and use are identified, if poverty alleviation is the ultimate goal: poor smallholders, whose improved access to irrigation is a powerful path to escape income poverty, but also to agricultural growth. Second, ways to reach poor smallholders and to endow them with access to irrigation assets are traced and illustrated: through the design of individual and collective technologies and accompanying pro-poor institutional arrangements of private ownership, collectively ownership or co-management, and of water markets. Further differentiation among the user group of poor smallholders identifies whether farm managers are men or women. This paper proposes generic tools for gender analysis of smallholder irrigated agriculture. Results of various applications of this tool are described that highlight a wide variation of female, dual or male farming systems over the globe. Lastly, concrete cases and generic lessons to reach both men and women, rather than excluding women, as often occurred in the past, are presented.

1. INTRODUCTION

Analyzing the gender and poverty dimensions of irrigation, as proposed in this paper, is basically deepening our understanding of specific user groups of irrigation technology, within a policy and intervention perspective to ensure their better access to this technology. Thus, gender and poverty analysis is a variation on a theme that is well known to irrigation engineers and other technical people: identifying and reaching the technology user. If irrigation technology development and use is seen as a joint endeavor between various stakeholders, the end-user is definitely a key partner. This partner can be a client who purchases equipment on commercial terms, or a beneficiary of a state or NGO-supported irrigation development program, or, more indirectly, a water buyer. The user-partner in technology development, whether male or female, is usually a farm manager motivated to invest in production-enhancing technologies, and/or to participate actively in collective scheme management, in order to ensure the productivity of his or her enterprise.

So two general questions figure high on the agenda of engineers and technical people:

- who is this user-partner?
- how to reach this partner?

This paper, then, explores some answers to these questions focusing on poor male and female farmers as partner-technology users and on ways to effectively reach them. Important lessons were learnt in this respect during the last decades of policy, research, and implementation on both poverty issues and gender issues in irrigation.

Evidently, poverty or socio-economic status and gender are two very different social variables, which, for long, were also treated as such. But both poverty and gender analysis in irrigation have in common that they target specific user groups and acknowledge, above all, that 'the users' cannot be lumped together into one misty mass, if not assumed to be all male, land-owning, larger-scale farmers. In this paper both issues are addressed. We first discuss the category of (potential) technology users who live below minimum standards of wellbeing, which, by definition, means living in poverty, and for whom farming is an important part of their livelihood strategies (Section Two and Three). Then, we will highlight the relevance of further differentiation among smallholders along gender lines, and tools to do so. Such tools enable engineers to define and reach both male and female partners in technology development conform the gendered organization of irrigated agriculture in any location (Section Four and Five).

2. POVERTY DIMENSIONS OF IRRIGATION DEVELOPMENT: WHO IS THE PARTNER?

If irrigation technology development is to contribute to rural poverty alleviation, the most direct way is to 'put irrigation technology to the hands of the poor' (Chambers, Saxena and Shah 1989). So engineers and technical people aiming at poverty alleviation select poor farmers as their primary partners. Improved control over water by the poor is an important means to better standards of living as this allows them to benefit from the well-known advantages of irrigation: higher and more stable yields during a longer period of the year. Moreover, water-induced agricultural intensification is especially relevant if farm sizes are small and land augmentation is unfeasible, which is the condition that most poor smallholders face. Irrigation is one of the few means open to them to improve agricultural production and incomes, and, evidently, even more so if other production factors and a favorable price and marketing environment are available as well. Intensive cultivation of irrigated high-value crops could even allow escaping poverty in spite of a very limited farm size.

During the last decades research on the productive capacities of poor people has fundamentally challenged the persistent assumption that there is an inevitable trade-off between poverty alleviation and agricultural growth. Improving poor farmers' access to irrigation, production-enhancing technologies, and rewarding markets was often found to be a viable means for agricultural growth as well: smaller farms tend to reach higher land productivity than larger ones (see box 1). As commonly recognized by now, endowing poor people with production factors is a win-win scenario (Jazairy, Alamgir and Panuccio 1992).

Box 1 Poverty alleviation and agricultural growth: a win-win scenario

Ample evidence suggests a synergy between promoting smallholder irrigated production and agricultural growth. Studies that have assessed the influence of holding size on land productivity in the green revolution areas like India, Pakistan, the Philippines, Sri Lanka, Bangladesh and the Philippines, show that smallholdings, compared to large holdings that have access to irrigation, tend to:

- have higher net sown proportions of their land irrigated
- have higher cropping intensities
- apply more fertilizer per unit of cultivated land
- cultivate more diversified, higher-value, and more labor-intensive crops
- obtain higher yields per crop per unit of land

(cf. Berry and Cline 1979; cf. Hossain 1989; Boyce 1987; Jazairy, Alamgir, and Panuccio 1992).

This inverse relationship between farm size and land productivity has existed throughout history and is worldwide. According to Sen (1962) the crucial explanatory factor for this inverse relationship is not the size of the holding as such, but the system of farming, i.e., whether it is wage-based or family-based. Family-based farming reduces supervision inefficiencies, while hiring and exchanging labor are on a more mutual basis. Hossain (1989) suggests that the need of poor families to meet the consumption requirements of all their members also compels them to work at below-average wage rates. This need to fulfill basic requirements for food encourages poor farmers more strongly than the better-off to adopt the green revolution package, including irrigation. Poverty induces technological innovation (Boyce 1987).

The inverse relationship between land productivity and farm size has not been found, however, in cases where the larger holdings are considerably better mechanized (Berry and Cline 1979). Studies have also shown that smallholders are less productive in households that give priority to distant off-farm employment and that cultivate only intermittently or lease-out their land (Sobhan 1993; Castellanet 1992).

Focusing on poor smallholders and net food producers as primary partners in technology development, as we will do in this paper, is not to deny other linkages between irrigation and the wellbeing of the world's poor. Two large poverty groups whose wellbeing also depends upon irrigated agriculture are:

- poor net-food buyers in both urban and rural areas, whose food consumption is considerably influenced by food prices; their food expenditures constitute up to 80 percent of their budgets. So agricultural productivity and prices of staple foods remain an important poverty issue as well.
    - poor agricultural wage laborers, who benefit from agricultural intensification, whether in large or small farms, provided net-labor replacing mechanization is avoided, and from employment opportunities in irrigation-related construction and maintenance.

Focusing on water for agricultural use affects only one dimension of wellbeing: incomes in kind or cash. The multiple other uses of (irrigation) water that are vital for people's livelihoods in general, and poor people's wellbeing and poverty alleviation in particular, include domestic uses, fisheries, livestock, small industries (Van Koppen 2000). These water – poverty linkages are omitted as well. Here we confine poverty issues to poor smallholders as primary partners in irrigation technology development. The next question, then, is how engineers can reach them and effectively include them in partnerships. These partnerships need to take into account, among others, poor people's small scale of farming, their limited capacities to make capital investments, and their weak social and political organization.

3. POVERTY DIMENSIONS OF IRRIGATION DEVELOPMENT: HOW TO REACH THE PARTNER?

Answers to the question how engineers can reach poor smallholders are multiple, and differ for the different forms of irrigation technology development. We illustrate main targeting factors in three forms of irrigation: externally supported collective irrigation, individual private irrigation, and water markets.

Collective infrastructure on poor people's land

Collective infrastructure, supported by governmental and non-governmental agencies, provides primarily poor farmers with access to water, if agencies target the improvement of poor people's land. Subsidies or long-term loan facilities for capital investment of new collective infrastructure, or a rehabilitation or extension of an existing scheme, remove a major bottleneck for technology adoption by poor people, which is their lack of sufficient capital for investment and their limited access to loans. Although management may be complicated, collective infrastructure can accommodate for many smallholders cultivating small plots. If land tenure remains the same when a collective scheme is constructed or rehabilitated, poor people are reached if their lands are selected for improvement. In poverty-stricken areas where land distribution is rather equal, any siting is mainly reaching the poor. But if land tenure is skewed, it is more difficult to find adjoining plots belonging to the poor. Nevertheless, several small-scale irrigation projects, such as the PATA project in Pakistan (Zigterman, 1996), still effectively implemented such policy of pro-poor site selection.

In case of a distributive land reform in the command area under construction of a new collective scheme, marginal farmers, women and/or men, and landless people are reached if new irrigated land is allocated to them. Several settlement schemes in the world followed this principle, the Mahaweli Ganga Project in Sri Lanka being a notable example. But smaller projects in Nepal or Peru also established, for example, a land bank to facilitate distributive land transfers (Martinez 1998; Pun et al. 2000).

While targeting the poor in collective irrigation is mainly a matter of arranging their access to irrigated land, the design of formal and factual membership criteria and other organizational aspects of water users associations further influence poor people's access to water during the use phase, especially in heterogeneous command areas. If many poor cultivators are tenants, for example, tenants' inclusion as members or semi-members is important. More generally, poor water users with small farms are empowered if rights, such as voting rights, are vested in all farm managers, irrespective of the farm size, and if obligations are proportional to farm size or water use. Further, it favors the poor if the organizational structure enables members to hold their leaders, who tend to be the male, literate and elite, more accountable by, say, a right of recall. The Andhra Pradesh Farmers Management of Irrigation Systems Act of 1997 contains all these elements (Government of Andhra Pradesh 1997).

Self-selecting private equipment

In a second mode of irrigation development, poor people become irrigators by purchasing equipment that is individually owned by them. Poor smallholders select the engineer's product. The technical challenge for engineers is to incorporate the needs and potentials of poor women and men in the design by keeping those technologies affordable and appropriate for small-scale farming. Distribution and marketing mechanisms,

spare part provision, and credit facilities are pivotal as well. The treadle pumps and low-cost drip irrigation are examples that fulfil these criteria (Shah 1997; Kabutha et al. 2000). In Bangladesh, treadle pumps have been bought by more than one million poor people. This equipment self-selects small farmers, whether land tenure is skewed or not, and hardly requires public investments.

Competitive water markets

A third mode of irrigation technology development and use, which will only gain in importance, are water markets (Shah, 1993). Water markets as they already emerged, for example, in South Asia since the fifties and especially since the eighties had considerable impacts on smallholders' access to water, and, thus, poverty alleviation. Market-steered water delivery services in general and to the poor in particular, are largely shaped by the technologies in use. Even the smallest mechanized lift irrigation pumps that are currently used in South Asia have a discharge that is often still too high to irrigate only the own plots of a farmer, as land holdings are typcially small and scattered over up to an average of nine plot fragments, as in Bangladesh (Jazairy et al. 1992). Gaining an additional income from water sale is indispensable to finance the investment costs, especially for relatively less well-off farmers. An offer of water by many smaller, competing pump owners results in excellent water service, also to the poorest smallholders who can not afford to buy the available mechanized pumps themselves. Although partnerships with the poor through water markets are indirect and steered by non-poor owners of equipment that is unaffordable to the poor, impacts on poverty alleviation can be considerable.

In the above-mentioned first and second mode of irrigation development (or combinations thereof), engineers and technical people focus on the specific user group of poor farmers by providing assets to these asset-less. In the third mode, other technology users are promoted to sell cheap and reliable water to poor smallholders. The next issue is to further differentiate within the user groups: is this poor smallholder a man or a woman, and what does this mean for partnerships in irrigation development?

4. GENDER DIMENSIONS OF IRRIGATION: WHO IS THE PARTNER?

Rationales for gender sensitivity

For long, the lack of differentiation among users covered an implicit male bias in agriculture and irrigation policy and intervention, both among poor and non-poor farmers. Only male farmers' roles were considered in analysis and only men were seen as partners in intervention. Nowadays, attention is growing for women's roles in agriculture and for women as potential partners in irrigation technology development in order to put water 'to the hands of poor women' as well.

A main rationale to overcome this bias is that more gender-balanced agricultural development in general and irrigation development in particular can improve agricultural incomes by rural women, besides those of men, for women's own welfare and that of their families and society. Four arguments justify the latter goal. First, among the poor, the incomes of both men and women are required to meet basic family needs. Also, in male-headed households, women and men are often responsible for different household needs; both types of needs are to be met. Moreover, women's incomes tend to benefit the family relatively more than men's

because, reportedly, world-wide women spend a higher proportion of their incomes on family expenditures than men do (Agarwal 1994). Evidently, in female-headed households women's incomes are usually the major source of income. A last reason to improve women's independent economic position lies in the proven relationship that women's own economic security is the crucial micro-level factor explaining a macro-level reduction in fertility rates (Safiliou 1986).

Similarly to research that debunked the stereotypes about poor people's productive capacities, there is ample evidence, that, if given the access to irrigation, labor, and other support, women are as efficient producers as men (see box 2).

Box 2. Women's productivity, access to inputs and human capital, and control over the output

Most estimates of male-female differences in technical efficiency show that male and female farmers are equally efficient managers, controlling levels of input and human capital (Quisumbing 1996; Udry et al. 1995; Adesina and Djato 1997). In one Kenyan case (Moock 1976), a simulation model predicted a 22-percent increase in women's yields in maize, bean, and cowpea plots if women farmers were given the human capital and input levels of male farmers (Saito, Mekonnen, and Spurling 1994: cited in Quisumbing 1996).

Two irrigation studies that compare the land productivity of irrigated plots under women's management to that under men's management confirm this and even indicate a higher productivity of female-managed plots. This was the case in the Dakiri scheme in Burkina Faso (Zwarteveen 1997). In Senegal, a higher density and higher-variety of crops were observed in women's irrigation schemes compared to men's schemes (Deuss 1995).

Women's productivity also depends upon their control over the output. In a Kenyan study by Ongaro (1988), the introduction of new weeding techniques by female heads of households increased yields by 56 percent and that in the farms of male heads increased yields only by 15 percent. Ongaro argues that female household heads may have a greater incentive to adopt better weeding practices (traditionally a woman's task) when they control the proceeds of their increased effort (cited in Quisumbing 1996; citing Elson 1995).

Jones (1986) and Carney (1988) studied the relation between women's labor input and their control over the output in the SEMRY irrigation scheme in Cameroon and in the Jahally Pacharr irrigation scheme in The Gambia, respectively. Lack of control over the output of husbands' production units and too-limited compensation by husbands were important reasons for women to reduce their overall labor input on their husbands' irrigated plots to the minimum level of culturally defined obligation (Jones 1986; Carney 1988). This was also one of the reasons for women in the Mwea settlement scheme in Kenya to completely abandon irrigated agriculture and to return to their original villages (Hanger and Morris 1973).

Gender analysis of irrigated agriculture to identify partners

For effective partnerships in irrigation technology development and use, policy makers and interventionists need to know who, within a poor farm household, is the key partner in a given context? Under which conditions is either a man or a woman, or both, the farm manager and, hence, the expected key beneficiary in collective schemes, investor in new private technologies, or buyer of water? The answer to this question depends upon the wider social organization of agricultural production along gender lines. Water is only one of the productivity-enhancing inputs in the farm enterprise, albeit an important one, and it is only in the light

of the whole enterprise that the farm manager, and its gender, can be identified. Socio-economic, cultural, and political gender patterns of agricultural production are dynamic, change over time, and greatly vary in the world. They are interwoven with other social variables, like age, class, ethnicity, occupational on-farm and off-farm activities etceteras.

A useful technique to assess the gendered organization of irrigated agriculture in any specific local context is to systematically disentangle whether men or women or both take important management decisions and carry out agricultural activities, with regard to a specific irrigated cropping unit, such as a plot, within the farm household. Generally speaking, farm management decisions vary from decisions on the ultimate use of the produce and the money gained, to access to key resources as land and credits, to production-related processes such as technology adoption and use, including irrigation, and the organization of labor. Agricultural activities encompass technology-intensive tasks such as ploughing, fertilizer application and pesticide management, and irrigation, which considerably enhance production or save labor, require specific skills, contacts with the outer world, and investments. On the other hand, there are the labor-intensive tasks such as transplanting, weeding, and harvesting, which are often unskilled and more of a drudgery. The precise decisions and tasks depend upon the activity and the specific local context. The analysis can be more or less detailed by including more or less decisions and activities.

The concept of the farm household that underlies this methodological technique considers the farm household as 'pluriactive' and as constituted of a range of cropping and other agricultural and non-agricultural production units or sub-systems, each managed by one of the (adult) household members. The manager of a unit has also the major say over the use of the output. Negotiations between household members for exchange of inputs and co-decision-making on the output occur, each 'trying to get the best deal out of it' (Safiliou, 1988). Genuinely joint management of a similar agricultural production unit by both spouses is an exception rather than a rule, as often appears when one probes the interviewee to get beyond the socially acceptable answer. Pluriactivity or diversification of on-farm and off-farm incomes within farm households is common all over the world and so is its intra-household specialization along gender lines. Hence, it is far beyond reality conceiving farming as providing the only income for a whole family, represented by a male head. Nor is it realistic to assume that the farm manager is always head of a household, or the main income provider.

Another implication of this conceptualization of household-based farming and livelihood strategies is that the farm manager is not necessarily the landowner or the one with the strongest rights to the land he or she cultivates. That is evident for male and female tenants but is also the case for women farm managers who have only use rights to the land they cultivate. Especially in communal land tenure in Africa and tribal communities elsewhere, women's tenure security to the land of their male in-laws that they cultivate on their own account is quite strong, unless women divorce. The fact that the male in-laws have strong rights to the land as well, such as the rights to transfer land for inheritance or to sell land, does not automatically render the male in-laws the most interested in enhancing the productivity of the enterprise. However, weak land rights may weaken the motivation of the farm manager to invest in increased productivity when this is land-bound, if arrangements for long-term sharing in benefits of the fruits are lacking.

Empirical research in which the gendered organization of agriculture and farm management in developing countries was assessed by applying this technique shows interesting patterns, and reveals, most of all, an enormous variation. The following examples highlight this variation.

Female production units: region-wise dominance

In several regions, especially in Southern and Eastern Africa, the majority of farm managers are found to be women. An example comes from the former homelands in South Africa in the area of Mathabatha Tribal Authority in the Northern Province. A study of 176 farm households with irrigated plots between 0.35 and 1.5 hectare in two formal and two informal irrigation schemes in a same sub-basin was carried out. The study shows that in 62 percent of all households women are the farm decision-makers for the irrigated plots, and in another 14 percent they decide jointly with their husbands. The proportion of women managers is even higher in the government schemes, where women decide alone or jointly with their husbands in 88 percent of the households (see Table 1). The somewhat lower proportion in informal schemes is related to the fact that they were recently started under the leadership of some men who just lost their jobs in a nearby mine.

This study also found that the land titles are quite often in the name of the spouse of the farm decision-maker. Among women decision-makers, land was registered in their husbands' names in 36 percent of the cases. Among male farm decision-makers, 10 percent cultivate land registered in the names of their female kin. So if in these schemes formal membership criteria were to be based upon land titles, overall 28 percent of the farm managers would be excluded (Van Koppen, Joubert, and Grobbelaar 2000). The South African National Water Act of 1998 provides well for this situation, as it vests water rights and membership of water users associations in the water users, irrespective of their land titles (Republic of South Africa 1998).

Table 1. Percentage of women and men farm decision-makers in two governmental and two informal irrigation systems in Mathabata Tribal Authority, South Africa

	Female Married	**Female Single Parent**	**Female Widow**	**Female Total**	**Joint**	**Men Single/ Married**	**Total**
Government schemes	26	8	38	72	16	12	100 (n=128)
Informal schemes	6	19	11	36	8	56	100 (n= 48)
Total	21	11	30	62	14	24	100 (n=176)

Source: Van Koppen, Joubert and Grobbelaar, 2000.

Other studies in South Africa's former homelands show a similar high percentage of farms led by women. Makhura and Ngqaleni (1996) estimated that in the Northern Province women-led farms constitute 70 percent of total dryland and irrigated farms. In Zimbabwe's communal areas, 61 percent of the farms were found to be managed by women (FAO 1998).

In some rural districts in Lesotho and Kenya, the majority of households are *de facto* and *de jure* female-headed households, with a proportion ranging from 50 to 90 percent (Safiliou 1985, 1994). A strong relation was found in these countries between women heading households and managing the farm as well (Safiliou, 1985).

Female production units: other types

In several settings, women are managing a lesser but still considerable part of the farming activities in a region, besides men. This is often the case in rural and agriculture-based female-headed households. A recent study (IICAIDB 1994) shows that in Central America, households headed by women account for between 29 and 48 percent of the total cases analyzed. In the Andean region, the number of such households ranged between 29 and 55 percent. Female-headed household that often have been missed in the past, are the consumption and production units in polygamous households headed by the respective wives.

Worldwide, many women in either male-headed or female-headed households have some personal land that they manage on their own. Own plots are widespread in Burkina Faso, for example, where women cultivate independently one-fifth to one quarter of the total land (Imbs 1987; Burkina Faso, Ministère de l'Agriculture et de l'Elevage 1989). Gardening around rural dwellings is often also a female farming system. A strong involvement of women as the key gardeners is reported, for example, in Bangladesh (Westergaard 1993) and India (Van Koppen, Nagar and Vasavada 2000).

In some agro-ecological environments, like wetlands in West Africa, most lands are farmed by women on their own account. In South West Burkina Faso 90 percent of the plots in rice valley wetlands are female-managed. The proportion of jointly managed plots is negligible, whereas men manage only 10 percent of the plots. In these wetlands, female dominance in farming is also reflected in land tenure and the management structures. Land constitutes the 'precious asset' that a mother transfers to her daughter or daughter-in-law. While the men of the clan of the land chiefs are responsible for the dry uplands, women land chiefs govern the wetlands. In one scheme, it is even a taboo for men to enter the valleys during the cropping season, as 'this would cause inundation' (Van Koppen, 1998). Wetlands in Zimbabwe, or *dambos*, are also reported to be mainly cultivated by women farm managers, although quantitative data are lacking.

Dual production units

Although exceptional, there are areas in the world, where reportedly both spouses decide jointly on farming and carry out activities together and in a rather egalitarian way. Raparson found this in irrigated agriculture in Madagascar (Raparson, 1989). In the Andean regions, like Ecuador, Hamilton (1998) describes indigenous egalitarian and bilaterally-headed institutions such as ownership and inheritance of resources like land and

water and intra-household consensual decision-making, based on the notion that 'having two heads is better than one'. She also shows how this has persisted in spite of the influence of male-dominated markets, agricultural development institutions and religion-based ideologies.

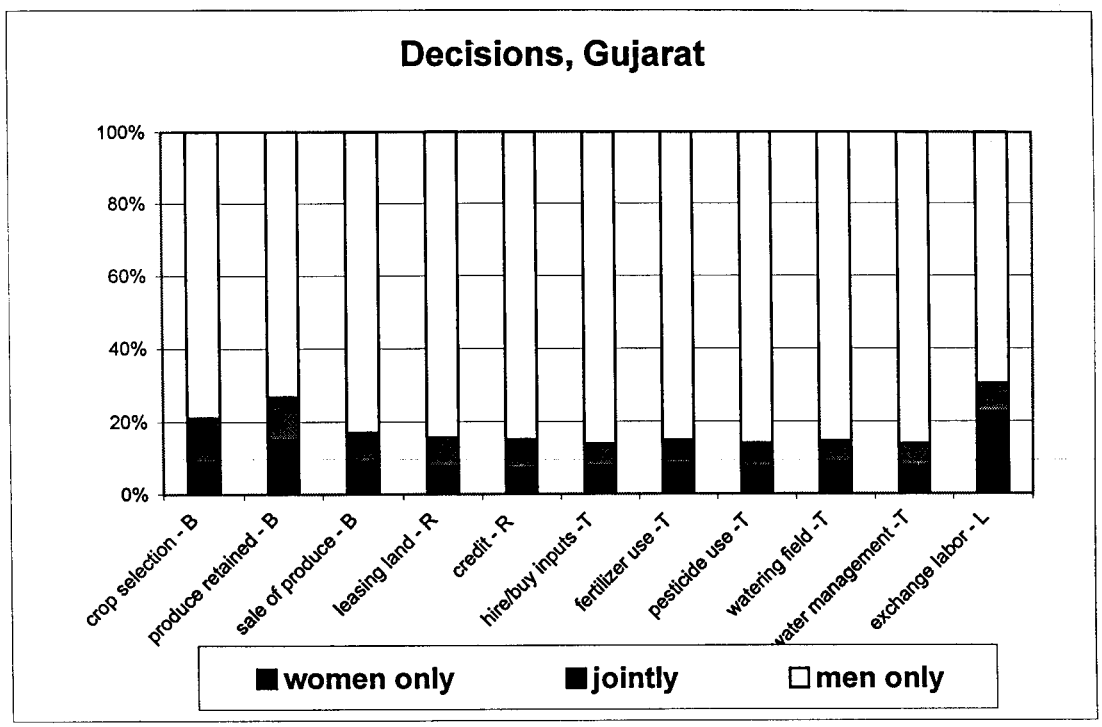
Male production units: region-wise dominance

At the other end of the spectrum, then, are the regions in which mainly men manage the farms. An analysis of gender patterns in agriculture in Gujarat and Andhra Pradesh, India, shows this gender-based distinction in farming roles (Parthasarathy et al 2000). As shown in Figure 1, in 341 households in Gujarat, India, the marketing of the produce and the application of technologies, including irrigation, are almost exclusively carried out by men, whereas women carry out the labor-intensive tasks. Decision-making is uniformly done by men as well, except for some 10 percent of the households. Only a slightly higher proportion of women decides either alone or jointly with their husbands on the organization of labor (which matches women's roles in labor provision) and also on the produce to be retained for home consumption (which matches their responsibilities for food preparation; less women co-decide about marketing of produce). This general pattern is remarkably similar in 359 households in Andhra Pradesh.

The gender of the household head influences this general pattern, as shown in Figures 2 and 3. In female-headed households in both Gujarat and Andhra Pradesh, women heads of households do more labor-intensive but also more technology-related work, and they have especially a stronger role in decision-making. But in still half of the female-headed households in Gujarat and Andhra Pradesh men decide on the various aspects of the farm enterprise. As the absolute number of female-headed households is very low, most women farm decision-makers still belong to male-headed households. Targeting female-headed households to capture women farm managers and irrigators, therefore, is not appropriate in this context. The two typical targeting mistakes would be made: first, including male farm managers (in female-headed households), and, second, excluding women farm decision-makers (in male-headed households).

Women's land ownership was found to affect the gendered division of tasks and decisions as well, but to a lesser extent than female headship. The impact of farm size is also found, but this appears even less strong. In operational holdings of less than one hectare, the proportion of households in which women either alone or jointly provide labor, carry out technology-related tasks and take decisions, is for all these aspects some 10 percent higher than in operational holdings of more than one hectare.

The implications of the existence of male farming systems, as just described, for gender policy and intervention for technology development are twofold. First, even if men decide most on farming, there is always a minority of women who irrigate and for whom irrigated farming is an important livelihood strategy, or there may be many women who cultivate on small portions of land, for example, homesteads. Special attention for these minorities is still warranted, especially among the poor. Second, for the majority of women in societies where farm decision-making is a predominantly male affair, the agenda to improve women's independent economic security is of a taller order than just intervening for one input, water. Rather than remaining an unpaid family laborer, women's access to critical resources like access to land and credit, training, and various technologies besides irrigation are at stake.



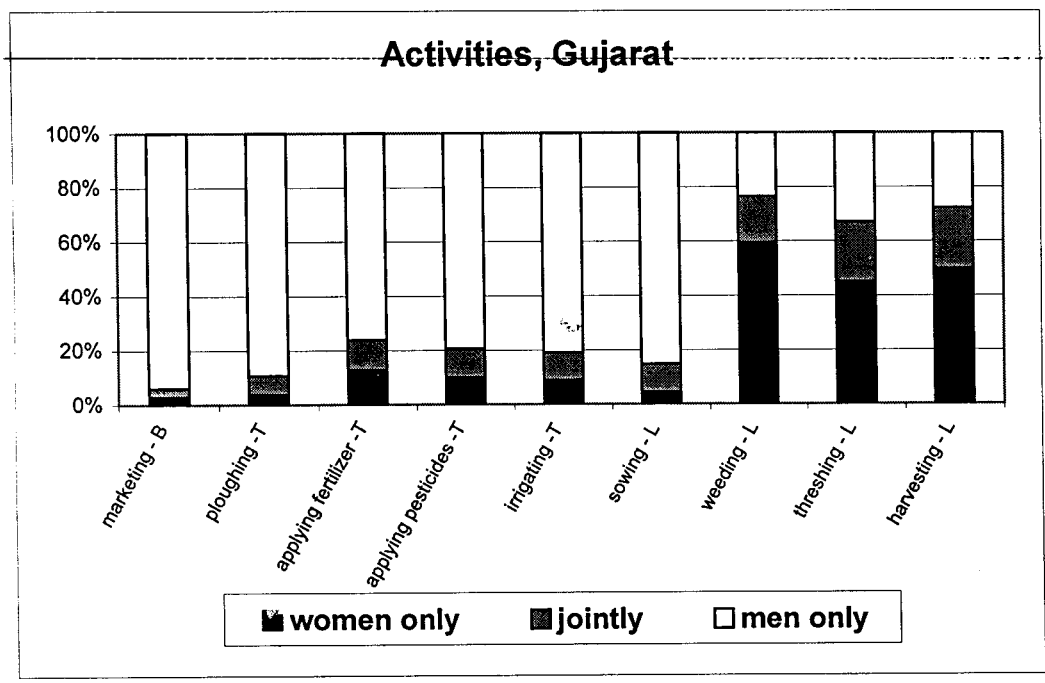


Figure 1. Percentages of households in Gujarat in which agricultural activities are carried out and decisions are taken by men, by women, or jointly

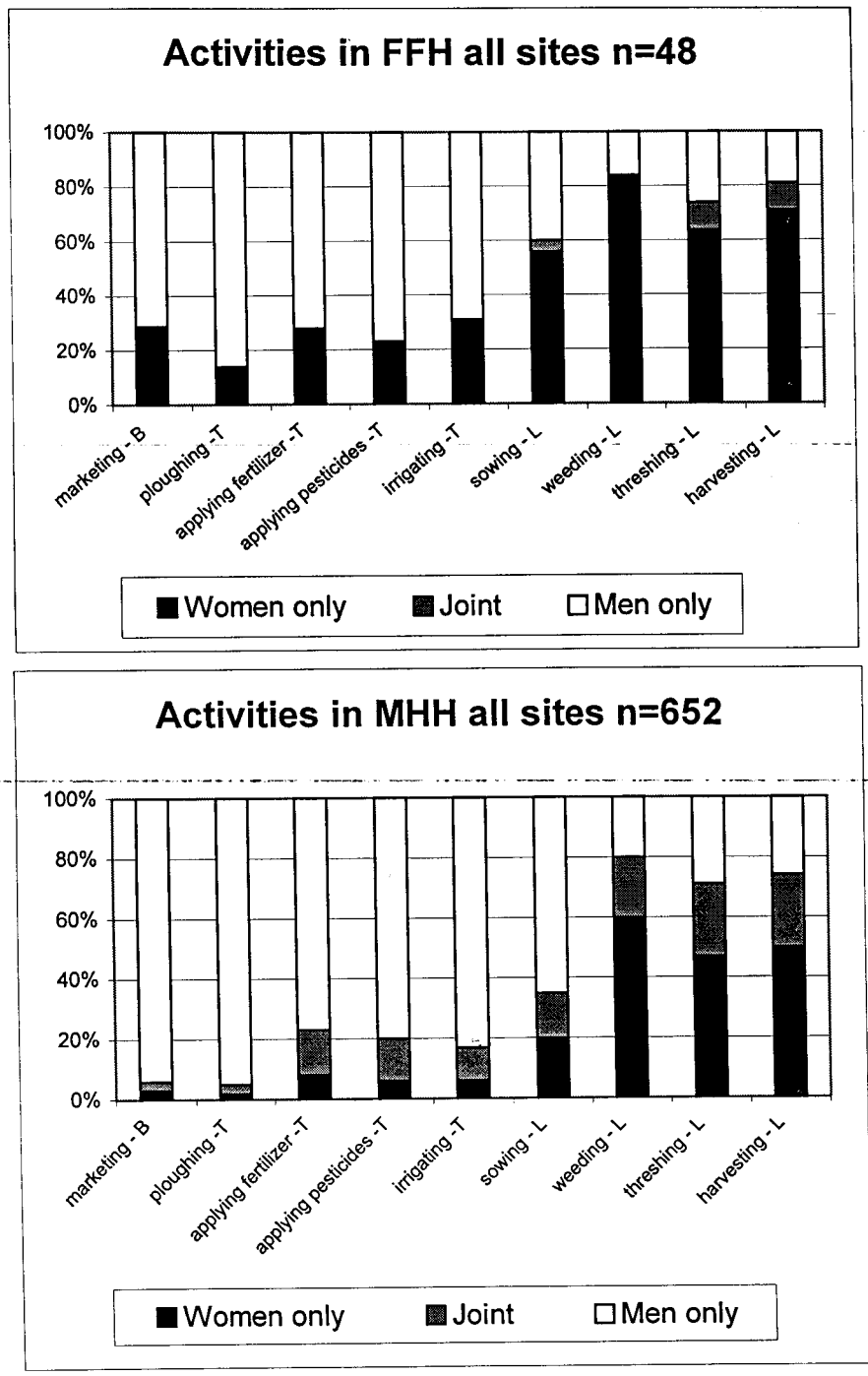


Figure 2. Percentages of female-headed households and male-headed households in Gujarat and Andhra Pradesh in which agricultural activities are carried out by men, by women, or jointly

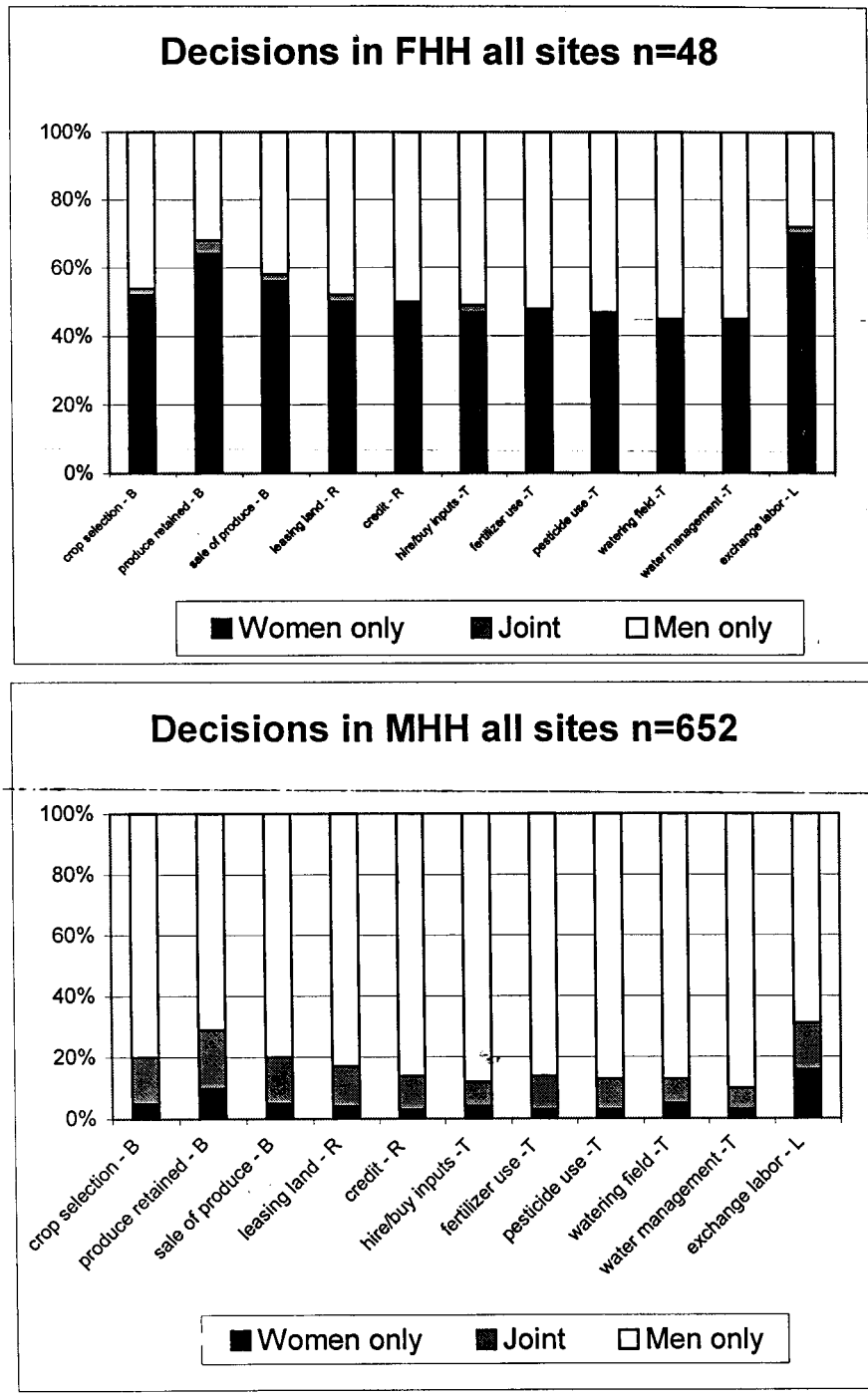


Figure 3. Percentages of female-headed households and male-headed households in Gujarat and Andhra Pradesh in which agricultural decisions are taken by men, by women, or jointly

5. GENDER DIMENSIONS OF IRRIGATION: HOW TO REACH THE PARTNER?

Learning from failures

Reaching both male and female farm managers as main partners in technology development, is first of all, a matter of clear understanding of the gender dimensions of farming in a particular context and, hence, the gender of the farm manager. Virtually all cases of policy and intervention that excluded women farmers in the past were characterized by a lack of recognition of women as actual farm decision-makers, let alone potential new decision-makers (Hanger and Morris 1973; Dey 1980; Carney 1988). Partly related to this, the intervention process to reach farm managers was ineffective as well. The process through which local partnerships were established often excluded women (and poor men as well). Most documented cases concern externally supported collective infrastructure; there is hardly any documentation on private equipment or water markets.

A clear example of perhaps all possible common mistakes in the process of building partnerships in collective infrastructure development were made in the early phases of an agricultural and engineering project to improve water management and rice production in wetlands in South-west Burkina Faso during the 1980s. As already mentioned above, wetland rice production there is a predominantly female farming system. The project's policy was to expropriate land, construct the water management infrastructure, and reallocate plots of equal sizes to former land right holders and, if plots were left, to new applicants. In the first two schemes, which were constructed simultaneously, the procedure that was factually implemented was the following.

- The project mainly interacted with the male village chiefs and authorities, under the assumption that they are the spokespersons for the rice cultivators. Major decisions were taken in this small forum of project staff and village elite.
- The focus was first on construction. In the small forum, the project negotiated a quick expropriation of the land to start construction, in order to meet the tight time schedule and spend the generous construction budget as foreseen in the contract.
- The final land re-allocation was decided upon in this small forum as well, under high time pressure to finalize both construction and re-allocation in time for the next irrigation season. Efforts to establish ex-post an inventory of the households with former rice plots, were made by interviewing the male household head (not the rice cultivators), but the resulting lists were finally not used at all. The small forum decided to reallocate land categorically to men only, both from households that cultivated rice before, and new households. The project justified this by assuming that rice cultivation is a family affair, in which the male head of the household represents the whole household, who would later take care of any 'private' redistribution of land within the family, if needed.

Thus the project uprooted the prevailing land tenure system. The women plot holders who had been convinced by the elite and husbands to give their land for improvement felt seriously 'betrayed' by their men. In these two first schemes women still provide almost all labor on the new rice plots, but they lost their say over the output to a large extent, as it had been changed into a male plot. Men, on the other hand, are not

interested to perform their duties as members of the water users association, such as maintenance work, because they are busy with their own farming activities. The project funds that were meant for future maintenance disappeared in the hands of the village authorities. One scheme completely collapsed.

In the third and later schemes of this project, the mere fact that there was a longer period between the first contacts of the project and the start of construction allowed a completely different procedure to emerge bottom-up. Almost in spite of the project management, women rice cultivators, male village authorities and the project's field staff designed and tested a new method, to which male kin readily agreed as well:

- Existing plot holders got to know about the plans for improvement, and a systematic inventory of them was compiled by the project's field officers in collaboration with the land chiefs who know exactly who cultivates which portion. The majority of plot holders appeared to be women. The identification of stakeholders on the right moment, so at the very start, was not only much more effective, but also took less time than efforts to reconstruct land tenure ex-post.
- Construction works only started after such insight in former land occupants and future beneficiaries had been arranged.
- New plots were first allocated to former plot holders, and the remaining plots to new applicants. Although men had all opportunity to apply for new plots as well, the majority of new applicants were still women, except for a small zone in the project area where uplands for men to manage rain-fed farming had become scarce.

The immediate identification and organization of current plot holders and future beneficiaries has smoothly been adopted as the formal project procedure in all later schemes. So in these later schemes, the process itself, which started with contacting and informing stakeholders themselves, automatically revealed that most farm managers are female. This was not only crucial for the women who now benefit from their intensified cultivation, but also for successful and sustainable technological improvement of rice farming (Van Koppen 1998).

Learning from positive cases

Both men and women farm managers were effectively reached through intervention processes that, right from the start, were based upon a sound understanding of the prevailing gender patterns of agriculture and in which the first procedural step was the creation of inclusive forums at local level for any further planning and implementation. One example is the Licto Irrigation project in Ecuador. In this area, with dual headship of households and farming, quite egalitarian land and water rights, and with considerable male migration, the intervening engineers started by organizing both men and women in a forum to discuss the proposed scheme layout and to plan the construction activities were planned. Moreover, before construction started, clear and inclusive membership criteria for the new water user association were established. Water rights were linked to obligations in the construction of the new scheme and the opportunities to build independent water rights in this way were opened up to both men and women. Up to 80 percent of all construction activities were carried out by women in working groups (*mingas*). Pregnant women also obtained water

rights, but they were granted dispensation from carrying out construction work (Arroyo and Boelens 1997; Video. Irrigation in Andean community: A social construction).

The importance of early inclusion of all stakeholders and of gender-balanced membership criteria from the very start of new organization-building onwards was also realized by the Provincial Irrigation Unit in the Nyanza Province in Kenya. In this region, women contribute over 60 percent of all hours spent in rice farming, including irrigation, and manage 64 percent of all plots (Hulsebosch and Van Koppen 1993). Nevertheless, for long, the general policy and practice of the governmental and non-governmental irrigation sector was to select mainly men as members of water user associations and their committees. In the new policy of this project, however, the agency changed its approach. A minimum of 50 percent attendance by women at the preparatory meeting of new water user associations was required. Moreover, parallel to these general meetings, women were organized in women-only groups and trained to articulate their interests and to participate effectively in the mixed meetings. This new policy proved to be effective. Compared to other schemes, which continued in the old way, women's attendance in the meetings and committees is higher in the project schemes. Furthermore, women's knowledge on project matters has increased, as well as the participation of women in water distribution and maintenance. Performance of women leaders is judged to be similar to that of male colleagues (Hulsebosch and Ombarra 1995).

These two cases in areas with both women and men farm managers illustrate that reaching both partners in collective technology development is rather straightforward, provided the intervening agency itself wants to open up its support and new opportunities to both men and women. Some extra effort may be needed to fill a gender gap in experience and training but this is usually a temporary matter that rapidly yields its results.

Also in cultural settings with male farming systems, in which the large majority of rural farm women are mainly unpaid family laborers, who rarely irrigate, NGOs have tapped opportunities to endow women, be it a very small minority, with irrigation assets. An illustration of women-targeted irrigation development in Bangladesh and India are NGOs who provide credits and other support to vest ownership of mechanized irrigation pumps in women groups. A study of 33 of such women groups in Bangladesh revealed that in two third of the cases, the pumps were primarily installed to irrigate male-managed plots and the managers were men or men jointly with women. These men could only access the NGO irrigation loans via the women groups. However, in the other third of the cases, the sale of water was important and women had obtained their own stake in pump ownership and management. In all these cases, the active support and empowerment by the NGO had been indispensable. The non-economic status of these women also improved in, for example, the eyes of the community to whom the women's group now rendered a public irrigation service (Van Koppen and Mahmud 1996). Another example is in India, where women became the owners and managers of pumps that irrigate homestead land, in which women do have a decision-making role. The Aga Khan Rural Support Program in Gujarat promotes this successfully (Van Koppen, Nagar and Vasavada 2000).

6. CONCLUSION

The questions 'who is my partner' and 'how can I reach him or her' with an explicit focus on poor smallholders and awareness of the gender of the smallholder, provide a wide range of answers, highlighting important gender and poverty dimensions of irrigation technology development and use. The answers, even though the empirical evidence is still anecdotal and the conceptual contours are still broad, enable engineers and technical people to better contribute to rural poverty alleviation and gender equity. The answers especially raise many new questions and technological and institutional challenges.

The importance of explicit differentiation between user groups and a policy choice to target poor women and men for irrigation-induced poverty alleviation and gender equity will strongly increase wherever competition over water intensifies. Under water scarcity, water use by one user group inevitably deprives the other of water. Water use by the better-off both within and outside agriculture deprives poor small farmers. Only if poor people are endowed with the means to capture water, they can realistically negotiate their share of water, which by itself is already a difficult battle. Only with access to technology can poor people claim what is more and more seen as a basic right: access to water for multiple facets of wellbeing, to reach at least minimum standards of wellbeing.

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