The Gatekeeper Series produced by IIED's Sustainable Agriculture and Rural Livelihoods Programme aims to highlight key topics in the field of sustainable agriculture and resource management. Each paper reviews a selected issue of contemporary importance and draws preliminary conclusions for development that are particularly relevant for policymakers, researchers and planners. References are provided to important sources and background material. The Series is published three times a year – in April, August and December – and is supported by the Swedish International Development Cooperation Agency (Sida).

Barbara van Koppen is leader of the Gender, Poverty, and Water Project of the International Water Management Institute. She co-ordinates comparative research in Asia, Africa and Latin America on poor women's and men's rights to water and irrigated land under growing water scarcity.

Contact address: International Water Management Institute, P.O. Box 2075, Colombo, Sri Lanka, Tel: +94 1 867404; Fax: +94 1 866854: Email: b.vankoppen@cgiar.org

1999

Executive Summary

In a climate of growing water scarcity, the irrigation sector will have a substantial role to play in implementing water savings. The question explored in this paper is how this can be achieved whilst still supporting the poorest sector of the world's farmers.

Under growing water scarcity there is a risk that well-off farmers and those with stronger water rights will impose the needed water savings on poor irrigators with weaker water rights. Moreover, poor female and male cultivators who have never had access to irrigation in the past risk being excluded forever. Both would aggravate rural poverty.

If the aim of water agencies and rural development agencies is to contribute to poverty eradication by improving poor women's and men's access to water, three areas need to be pursued:

1. Reducing water consumption by the better-off by redefining and reducing their vested rights, for example, through the use of water ceilings for large consumers, and discouraging new water rights for the better-off in water-scarce catchments.

2. Protecting current water rights of poor women and men. Wherever the poor have established rights to water and irrigated land, these rights need to be protected and strengthened. Public irrigation agencies have a major role to play in this through their ability to assure water allocation to areas where poor water users are concentrated; to strengthen rights of the landless and the poorest land users; and to organise them into decision-making bodies which can help protect their rights.

3. Developing new infrastructure targeted to poor women and men. Managing water scarcity should not be confined to those who already have access to irrigation. This would exclude permanently all those excluded in the past. The water needs of many poor people are still unmet, and new infrastructure development for them is an urgent requirement.

The paper summarises some important lessons from the past decades of irrigation development. Although many schemes led to the highly skewed control over water along class and gender lines, there are exceptions. Several governmental and non-governmental agencies succeeded in vesting rights to irrigated land and water primarily in poor men, and sometimes in poor women as well. These lessons are still valid, especially in this era of water scarcity.

SHARING THE LAST DROP: WATER SCARCITY, IRRIGATION AND GENDERED POVERTY ERADICATION

Barbara van Koppen

There is growing awareness that water is becoming an extremely scarce natural resource in many regions of the world. As one of the largest consumers of the world's water resources, the irrigation sector will have to bear a substantial part of the needed water savings. However, if targeted correctly, irrigation has an important role to play in poverty eradication. If curtailed water use is imposed on the sector as a whole there could be serious implications for the poor. The affluent irrigators who tend to have the stronger water rights are likely simply to force the needed water savings upon the poor with the weaker rights. Moreover, it is likely that poor farmers without any water rights will never receive access to water.

Given that irrigated agriculture has proven potential to satisfy poor people's basic income needs (Chambers *et al.*, 1989; Shah, 1993) this paper explores two questions:

- Are there still ways to improve poor women's and men's access to irrigation water, despite growing water scarcity?
- What is the role for governments and NGOs for whom poverty eradication is one, if not the most, important aim?

Irrigation's Role in Poverty Alleviation

Poor smallholders who gain access to irrigation water benefit from higher crop productivity for a longer period of the year, and with fewer risks. Irrigation allows more food to be produced from the same-sized land holding. This is crucial, especially where land reforms have stagnated and there are no other employment opportunities. Even a tiny irrigated plot significantly *"adds to the range of options"* available in the livelihood strategies of the poor (Chambers *et al.,* 1989). There are also several indirect linkages between irrigation and poverty alleviation (see Box 1).

Box 1. Indirect impacts of irrigation

It is not just poor farmers who benefit from irrigation. Two other poverty groups benefit indirectly from irrigation. The first group consists of the poor who have to buy most of their food. Higher food outputs brought about by irrigation tend to lower food prices. This is crucial for the poor who spend up to 80 percent of their incomes on food. This relationship will remain valid under increasing water scarcity, if irrigators continue to grow staple food crops (Mellor and Desai, 1985; Jazairy *et al.*, 1992). Second, the introduction of irrigation creates employment for poor wage labourers. Intensification of cropping absorbs more labour, either local or migrant, for a longer period of the year (Agarwal, 1986). Paid construction and maintenance of irrigation infrastructure also provides employment. The introduction of irrigation usually triggers economic development, creating further employment and self-employment opportunities.

It is often assumed that there is a trade-off between poverty alleviation and maximising agricultural productivity. However, much evidence points to this persistent assumption not being true (Box 2).

Box 2. Poverty alleviation and productivity

Smallholders can achieve higher land productivity than large holders. Subsistence pressure to meet the consumption needs of all family members necessitates working at below average wage rates. Moreover, family-based, rather than wage-based farming, reduces supervision inefficiencies, while hiring and exchanging labour is on a more mutual basis (Sen, 1962). Under many conditions this inverse relationship between holding size and land productivity also holds after introducing the Green Revolution package of irrigation, high yielding varieties (HYVs) and fertilisers (Mellor and Desai, 1985; Hossain, 1989). Similarly, women are reported to be as efficient farmers as men, provided they have similar access to human resources and agricultural inputs (Quisumbing, 1996). Therefore, it is a viable path to agricultural growth to endow both poor women and men with resource rights and basic services (Jazairy *et al*., 1992). Land productivity in larger holdings will only exceed that of smaller holdings if (1) the larger holdings heavily mechanise their cropping activities; (2) if smaller farmers do not have access to HYVs and fertilisers; and (3) if the livelihood diversification strategies in poor households warrant longer-term absence by most of its members for more remunerative employment elsewhere.

However, the ultimate effect of irrigated agriculture on poor people's well-being also depends on many other production and marketing factors. Moreover, low income is only one aspect of the multiple dimensions of deprivation that characterise poverty.

Despite the many benefits of irrigation for the poor, relatively few poor men and even fewer women have been able to get access to irrigation water. And where they

do, their water rights are weak. If water is abundant, weak water rights can still result in adequate water delivery at field level. However, if water becomes scarce, weaker water rights negatively affect productivity. In the longer-term this might induce those with limited water rights to give up irrigated agriculture, and lease out or even sell their lands to the farmers who have more control over water. Derivative water rights rather than independent rights also make tenants dependent on landowners, or women dependent on their male kin.

The highly subsidised expansion of irrigation in the last decades has largely benefited the better-off farmers. However, there are some significant exceptions, and in the next section I focus on these exceptions and trace the implications for water policies that work and effectively contribute to gendered poverty eradication. I then place these insights from the past in the context of growing water scarcity in the future.

Making Water Policies Work for the Poor

Investments in infrastructure

Whilst rights and competition for access to the sources of irrigation water (such as natural surface flows, lakes, or groundwater reserves) are a key concern in the water scarcity debates, the fact that access to irrigation infrastructure is of more immediate importance is often ignored. People without any means to capture water are *a priori* the weakest party in negotiations to tap water from a commonly shared pool. Often they are even completely ignored as a party.

Generally, 'access to water' implicitly refers to water in the right quantity and quality, at the right moment, and in the right place. In short, water available for use. In some situations this is water in the form in which nature offers it. Rain on agricultural lands is the most important example. But more often it is water conveyed by infrastructure which can include reservoirs, dams, diversion structures, canal systems, pipes, sprinklers and drips, ground water pumps, soil and water conservation measures, water harvesting techniques, recharge structures, and so on. Investments are in the form of labour, kind, cash, and skills. Investments in infrastructure can be individual but they are usually collective, and may unite many thousands of people. Collective action is often needed because of the nature of the water problem and because important economies of scale can be achieved.

This role of infrastructure in delivering water also has legal implications. All over the world, and throughout history, investors in irrigation infrastructure and their descendants or successors have firm claims on the water conveyed (Coward, 1986). If investments, for example, by a wage labourer or a wife, are made in somebody else's name, this other person or institution obtains the rights. There is no other natural resource for which the investments in the improvement of the resource are so closely

linked to claims on the improved resource. Each major rehabilitation endeavour offers new opportunities to change the composition of the group of investors and to redefine rights.

Investments in the construction of new infrastructure, and to a lesser extent in its rehabilitation, are usually the most expensive and laborious part of water development. Maintenance and operation require lesser efforts. This further explains why infrastructure development is a most critical step in inclusion and exclusion processes in people's access to water. Therefore, we will mainly address the question: how are some people included in investment processes in infrastructure, whereas others are excluded, and what does this mean for poor women and men?

Depending upon agencies' involvement in investments in infrastructure, either during construction or rehabilitation, they play very different roles in inclusion and exclusion processes. This has implications for poverty alleviation policies as well. Public and private irrigation are discussed in turn below.

Inclusive Public Irrigation

Here I define public irrigation as any irrigation which is provided by an agency or the state, rather than by a private individual. In public irrigation, agencies (whether governments or NGOs) bear most of the investment costs for infrastructure construction and rehabilitation. Water users, including the poor, are basically water service receivers. When agencies take up this important role of investor, they have a strong role, first, in vesting rights to irrigated land, and, second, in selecting those who will, and will not, have rights to water.

The power which these agencies have in allocating rights to irrigated land and water can have serious implications for equity if abused or ill-conceived. Box 3 describes the case of an inland rice valley development in South West Burkina Faso. This is a classic example of how many public irrigation agencies formally and informally allow the local male elite to gain disproportionate control over the newly developed or transferred water resources. Sometimes this directly harms poor land users and women.

At least six elements in the approach of this project are not unique. Many public irrigation agencies:

- ignore the aims of their own project documents
- only interact with the male elite
- focus on construction and are evaluated on construction targets
- expropriate resource rights and start constructing without an inventory of pre-project rights and without procedures for compensation and reallocation
- use demographic and administrative concepts of the household represented by the

Box 3. Exclusion in public irrigation: the case of an inland rice valley development project, Burkina Faso

This government project was supported by foreign funding and technical assistance. In the matrilineal communities in this region, rice valley plots are women's personal fields, whereas men control rainfed uplands. Women provide most of the labour in valley rice cultivation, have much stronger land rights than men, and control the output accordingly.

In the project document the role of women was acknowledged; one aim of the project was to improve the incomes of women producers and to reallocate the new plots to them after the expropriation needed to improve the valley. Social scientists played only a minimal role and only in the pre-project phase. Whereas they highlighted women's role as labourers, they failed to recognise them as right holders. They ascribed a much stronger intra-group control over valley land to male land chiefs and husbands than existed in reality, emphasising their roles as representatives to outside groups. They ignored the crucial intra-scheme functions of female land chiefs. They also failed to highlight the intra-household organisation of rice production, and introduced notions of a 'family rice farm' instead. No procedures to identify current land right holders were proposed.

The project was under pressure to construct eight schemes in four years. The project management, who all had a technical background, consulted the male village elite and local administrators on the technical design. The future command area was quickly expropriated in order to start construction, and well-paid male labour was mobilised. During construction, demographic surveys traced the former rice plot owners, and identified all women and men interested in a new plot. Even lists of the tax offices were used. The household, headed by a man, was the unit of analysis in these surveys.

When construction was almost complete, the project officers and male elite decided on the final allocation criteria. In this restricted forum it was decided to reallocate the improved plots to male household heads. Women were not consulted. Thus men got rights to land they never had in the past. The surveys were hardly used. Subsequently, household heads and other men kept at least a portion of the plots for themselves. Their wives had to provide the labour on these portions, but men controlled the harvest. The women, who had supposed that they would get their lands back in their own names, felt seriously 'betrayed by their men'.

In the next two schemes several years passed between the first contacts and the construction activities. This allowed the field staff and local people to develop their own procedures for the expropriation and reallocation of valley land. The women were better organised, having seen the negative events in the neighbouring scheme. Thus, all former plot owners were registered in time, and got one new plot of standardised size in return. Neither land chiefs nor husbands opposed this procedure. Gradually this became the formal project procedure. Furthermore, if all former right holders got a plot and there were still plots left, new candidates, whether male or female, could apply. The majority of new applicants are women.

Source: Van Koppen, 1998

male head in order to define resource rights
- ignore egalitarian aspects in local legal arrangements

However, through better-designed projects, agencies could have a constructive role to play in ensuring equitable access to and rights over irrigation water. Agencies, and especially the state, have three major advantages for ensuring that primarily poor people get access to newly developed irrigated land and water:

1. They have the financial and legal autonomy to select their preferred target group. Improvement of poor people's well-being is often their explicit aim.
2. They are in a position to solve a typical problem facing the poor - lack of capital or credit for long-term investments in infrastructure. Even if water users have to contribute a larger share of these investments by taking loans, public agencies providing such loans would still solve this liquidity problem.
3. Agencies can organise users for collective activities. Poor people's own degree of organisation and their capacity to resist encroachment by better-off irrigators is usually limited.

Despite this, there are only a few examples of interventions in which public agencies have succeeded in including primarily poor men, and sometimes poor women as well, as right holders to irrigated land and water (Van Koppen, 1998). The lessons from these examples are summarised below.

Equitable rights to irrigated land

• Selecting poor people's land

The selection of the site for irrigation infrastructure determines whose land is improved. The scheme lay-out also influences how well different parts can be irrigated. These choices are not just 'technical'. On the contrary, if there is no land reform in the command area, the site-selection and lay-out directly determine which people will gain rights to and benefits from irrigated land. Targeting irrigation development to areas where poverty prevails is likely to contribute to poverty eradication. In areas with skewed land tenure, targeting of small-scale infrastructure like tube wells would also be feasible.

• Implementing land reform during construction of irrigation facilities

Public irrigation agencies can often implement land reform in the command area (Chambers, 1984), ideally before a scheme is constructed. This has allowed poor landless men and marginal farmers to gain access to irrigated land in both small schemes and large settlement schemes, for example in Tunisia, Egypt, and Sri Lanka (Jazairy *et al.*, 1992). In Africa especially, there are also women's groups who got collective access to land for horticulture, although the sizes are very small. These sites used to be controlled by men under customary law in patrilineal inheritance systems (Carney, 1994; Projet Sensibilisation, 1995).

In these land reforms pre-project land right holders can still gain, because a smaller portion of irrigated land has the same value as a larger area of rainfed land. This enhances the political feasibility of land reform considerably. In a number of countries the land reform law sets different ceilings for rainfed and irrigated land. Thus, the transformation of rainfed land into irrigated land under new infrastructure development can be accompanied by the expropriation of the land above the reduced ceilings and its redistribution among the poor. However, enforcement of this law tends to encounter similar problems as reform of rainfed land.

• Strengthening poor people's rights to irrigated land in the use phase

Whilst the most radical changes in land tenure can generally be made before the construction phase, land tenure in the command areas changes during the use phase as well. Migrants may gradually move in and settle in expanding schemes. States and projects can support poor men, and especially poor women, to settle in this way and obtain strong land titles.

Further, under seasonal or permanent water scarcity, the size of the command area that is actually irrigated is often reduced. If only the upstream parts remain irrigated, seasonal land reforms can be stimulated. Sometimes projects can build upon existing local egalitarian practices, in which the farmers upstream are obliged to lease out part of their plots to people downstream. In cases of water rotation or the closing off of certain distributories of the scheme, agencies can prioritise water provision to areas where poor people farm.

Intra-scheme rights to water

• Vesting water rights in landless people

Clearly people who remain entirely landless cannot use water rights for agricultural production on their own account. However, they can sell their water, at least if there is a demand from farmers who could not otherwise get sufficient or timely water. The buyers should pay enough to compensate for the obligations borne by the landless sellers (Box 4).

Box 4. Water rights for the landless

The Sukhomajri irrigation scheme in Haryana, India, is the most renowned example of an agency, in this case the Ford Foundation, that included the landless as water right holders. The project developed tanks for irrigation as one component of broader watershed and forestry management. An equal division of water rights and obligations among all community households was pursued. Some landless people used their rights to lease land. However, new private tube wells were recently installed. This decreased water scarcity, and thus the demand for water from the landless (Sarin, 1996).

• Vesting water rights in land users rather than owners

Many poor cultivators and water users do not own the land they cultivate. Millions of female and male tenants lease the land from better-off landlords, although under some conditions poor land owners are the ones to lease out their land to, for example, commercial agricultural companies. Women are the world's largest group of cultivators, and often the actual water users and farm decision-makers as well, who lack independent land titles by cultivating the land of their in-laws. In customary law male and female farmers tend to have firm use rights, but not the ultimate authority over land. In all these cases, agencies can strengthen poor women's and men's water rights by vesting rights in land users, irrespective of the nature of their land rights (Box 5).

Box 5. Legal approaches to equity for land users

South Africa's National Water Act (1998) is the first law in the world which separates land and water rights in an effort to redress past gender and racial inequities. Through this act the government formally abolished the riparian water rights that white large landowners used to have (Republic of South Africa, 1998). Less fundamental, but pointing in the same direction, is the irrigation management transfer policy and law in Andhra Pradesh, India. This law stipulates tenants' membership rights in the new water users associations. However voting rights are still vested in the landowners (Andhra Pradesh Government, 1997).

• Vesting water rights in both poor women and poor men

Allocation of external resources to the head of a household, supposedly a man, has excluded many women of all classes from independent access to these resources, including water. To avoid this, this criterion is increasingly replaced by dual membership per household, so by both one man and one woman of a household. However, this still leaves the problem in an extended household of defining *which* man and woman. In a growing number of allocations of resource rights, household-based criteria or criteria based upon marital status are either completely abandoned (Sarin, 1998) or priority is given to female-headed households (Deere and Léon, 1997). Women's membership of committees of water users associations and their participation in meetings are increasingly fostered by many public irrigation agencies. They adopt guidelines and quota for female participation in the formerly male-dominated forums for decision-making on water affairs. This is especially valuable if agencies simultaneously empower organised groups of poor women and their representatives to formulate and voice their interests (Hulsebosch and Ombarra, 1995).

Inclusion of both women and men in co-investing in infrastructure construction and rehabilitation also leads to gender-balanced water rights. The underlying general principle is that, whereas agencies finance most of the costs, co-investments by users are the basis for users to establish water rights. In the use phase water rights are confirmed by help with maintenance and other obligations. Often women carry out

these obligations anyhow. Inclusion is then a matter of recognising these contributions in women's own names, and linking obligations to rights for women on the same footing as for men. It is also important to include all types of labour contributions, so also tasks that may be specific for women, such as providing food and drinks during community work.

Some women may be exempted from the obligations, and still get water rights, for example pregnant women, or elderly widows (Arroyo and Boelens, 1997). However, a paternalistic attitude of 'protecting' women from labour investments may disguise their lack of rights. Without such rights women are worse off. Then they have to ask, or even pay, male kin or other water right holders to provide the water they need (Adams *et al.*, 1997). Women's widely reported willingness to bear the obligations in order to get rights, or their protest if they are denied these opportunities (Prins, 1996), underline the need for agencies to ask the women themselves. The key issue is the assurance that obligations lead to rights. This is arranged through timely and transparent procedures that have crystallised before the investments are made, and through adequate registration of labour contributions.

Private irrigation

In private irrigation, individuals or private institutions bear most of the investment costs and become the owners of water equipment. They select the site and manage water primarily according to their own needs and wishes. They can use water for their own cropping or for sale. In private irrigation, water users can also buy from private owners. Inclusion and exclusion processes by which some people become equipment owners or water buyers, and others not, are more autonomous and steered by market forces. One form of private irrigation is local or traditional irrigation, which may be centuries old and quite large-scale. The current upgrading and rehabilitation of traditional irrigation systems, however, is often publicly financed, and defined as public irrigation. Below we focus on irrigation by modern private equipment.

What is the role for external agencies in ensuring equity in private irrigation systems? At best they can try to redress intrinsic exclusion and improve the terms of inclusion in private irrigation as described below (Shah, 1993; Van Koppen and Mahmud, 1996).

Inclusive Private Irrigation

• Exclusion and inclusion as owners

To become a private owner of irrigation equipment one has to make long-term investments, and, in the case of collective enterprises, a certain degree of organisation is required. Most modern equipment, like mechanised pumps, drips and sprinklers, is capital-intensive and adapted to relatively large scales of farming. Poor people have weaker access to the loan facilities than the better-off, and their degree of organisation is often too limited to reach a scale of collective farming that is optimal for the

available technology. Market demands of large numbers of medium-size farmers may induce some commercial development and trade in smaller-scale equipment. However, generally speaking, modern private irrigation intrinsically excludes poor people as owners of equipment.

As market forces fail for the poorest, non-commercial NGOs and governments can play an important role in developing and spreading technology that is appropriate for them. In this way, for example, treadle pumps in Bangladesh became more sophisticated and spread over the world within a decade. As long as commercial banks refuse to provide credit facilities to poor farmers, governments and NGOs also have an important role to play here. Lastly, they can support the poor to organise for collective enterprise (Box 6).

Box 6. Targeting private irrigation to poor women

A study in Bangladesh of 33 female irrigation groups supported by six NGOs highlights the importance of the targeting approach of the NGO (Van Koppen and Mahmud, 1996). All NGOs start their intervention by organising marginal and landless women and men into gender-specific groups. They then provide support for a range of activities. One possibility is to take loans to purchase a mechanised pump and start an irrigation enterprise, both for irrigating own household land and for selling the excess water. Men are especially interested in irrigating rice, the main irrigated crop in Bangladesh, as rice farming is predominantly their domain. Three of the NGOs consider their members as mediators of NGO-resources to other household members. Women's role as mediators gets more emphasis than their empowerment. In these NGOs the loans were taken in women's names because their male kin had no access to the NGO resources themselves. The enterprises were fully managed by the men, or jointly by women and men. On the other hand, with the NGOs that explicitly aim to empower women, and organise and train women accordingly, half of the women's groups took the initiative and managed the enterprise mainly themselves. Thus, women who were traditionally not involved in mechanised irrigation became pump owners and water sellers.

Women's participation in the female-managed irrigation groups also improved their non-economic status. Some expressions of this are:

"I became clever. Now I also feel more confident to talk to the richer people in the village" (woman member).

"These women understand much better now. Nobody can fool them anymore" (related man).

"Women are developing. Now they are able to get people to do things for them" (unrelated man).

"When women took over the pump, the yields became higher because water distribution improved. Women keep their promise to give water, while a male pump owner would not" (water buyer).

• Inclusion and terms of inclusion as buyers

The third form of access to water is as a buyer from private owners. Water buyers are dependent upon the terms of inclusion set by the sellers. The more the sellers, in their turn, depend upon the buyers, the better the water service will be. The private South Asian water markets are clear examples in which competition in the offer of water by several pump owners in the same area considerably reduced water prices and improved water delivery. The government policy of flat electricity rates that encouraged optimum use of the pumps further enhanced the offer of water (Shah, 1993). A competitive market is important for all water buyers, but especially for the poor who can not afford to purchase equipment themselves. However, this policy that works for the poor accelerates ground water extraction and raises the issue of water scarcity.

Policy Implications Under Growing Water Scarcity

These insights from the past give us a better understanding of how irrigation support can become more inclusive. However, are they still valid in a future of growing water scarcity? Demands for fresh water are rapidly growing. Groundwater has already become less accessible either seasonally or permanently. Water is more polluted. In an increasing number of basins in the world all available water resources are already committed, in the sense that people have already established claims to all the water available. In these basins water use by the one immediately impinges upon the volumes and quality of water available to the other (Seckler *et al.*, 1998).

If the aim of water agencies and rural development agencies is to contribute to poverty eradication by improving poor women's and men's access to water for productive use (and other uses), a vast and almost entirely new agenda emerges. Policy makers need to address at least three issues.

1. *Reducing water consumption by the better-off.* Wherever water savings are needed, they should be borne by the better-off, both within the irrigation sector, but also outside the irrigation sector. Their vested rights need to be redefined and reduced, for example, by directly or indirectly introducing water ceilings for large consumers. In basins in which all water is already committed, the better-off should be discouraged from establishing new water rights through new infrastructure development. It is much more difficult to impose water savings once the investments are made.

2. *Protecting current water rights of poor women and men.* Wherever the poor have established rights to water and irrigated land, these rights need to be protected and strengthened. Within existing public irrigation schemes any endeavour that implies the redefinition of water rights; for example, rehabilitation, irrigation management transfer, changing water allocation schedules, or water trade, should be used entirely to that end. That means assuring water allocation to areas where poor

water users are concentrated, strengthening rights of the landless, poor land users irrespective of their land rights, and both women and men, and effectively organising them into decision-making bodies in order to co-formulate rights and assure the realisation of rights.

3. *Poor private owners of equipment need to have assured water sources.* The situation whereby only owners of expensive pumps powerful enough to reach the lowering water tables can irrigate from groundwater reserves should be avoided. Avoiding monopolisation and fostering a competitive market for water are also in the interests of poor water buyers.

4. *Developing new infrastructure targeted to poor women and men.* Managing water scarcity is not an issue confined to those who already have access to infrastructure. This would imply that all those who were excluded in the past are excluded forever, and basically further 'punished' for earlier exclusion. The water needs of many poor people are still unmet, and new infrastructure development for them is an urgent requirement.

   Nowadays, new infrastructure development will generally be more expensive than in the past, because the most accessible water resources have already been exploited. Moreover, agencies' willingness to subsidise infrastructure development as generously as they did for the better-off farmers in the past is disappearing. Long-term financing facilities for the poor are still absent. On top of this, in basins in which all water is already committed, these new water rights by the poor will be at the expense of existing water claims by current water users who claim rights to past public or private investments in the equipment. This transfer of rights needs to be negotiated.

In summary, the context for agencies to provide effective support to poor women and men is rapidly becoming more complicated. Therefore, support needs to be provided as soon as possible and it needs to be well targeted. This implies that under growing water scarcity the past lessons for inclusive irrigation policy and intervention, as described above, will be more relevant than ever.

References

Adams, WM., Watson, EE. and Mutiso, SK. 1997. Water, rules and gender: water rights in an indigenous irrigation system, Marakwet, Kenya. *Development and Change* 28: 707-730.

Agarwal, B. 1986. Women, poverty, and agricultural growth in India. *Journal of Peasant Studies* 13(4).

Agarwal, B. 1994. A field of one's own. Gender and land rights in South Asia. *South Asian Studies* 58.

Arroyo, A. and Boelens, R. 1997. *Mujer Campesina e Intervencion en el Riego Andino. Sistemas de riego y relaciones de género, caso Licto, Ecuador*. Servicio Holandés de Cooperación al Desarrollo (SNV), Central Ecuatoriana de Servicios Agrícolas (CESA) and Sistema de Capacitación en el Manejo de los Recursos Naturales Renovables (CAMAREN), Quito, Ecuador.

Carney, J. 1994. Gender and the sustainability of irrigated farming in the Gambia. In: Yngstrom, I., Jeffery, P., King, K. and Toulmin, C. (eds). *Gender and Environment in Africa. Perspectives on the politics of environmental sustainability*. Centre of African Studies, University of Edinburgh.

Chambers, R. 1984. Irrigation management: ends, means, and opportunities. In: Pant, N. (ed). 1984. *Productivity and Equity in Irrigation Systems*. Ashish Publishing House, New Delhi.

Chambers, R., Saxena, N.C. and Tushaar Shah. 1989. *To the Hands of the Poor. Water and Trees*. Intermediate Technology Publications, London.

Coward, WE. Jr.. 1986. State and locality in Asian irrigation development: the property factor. In: Nobe, K.C. and R.K. Shanpath (eds). Irrigation management in developing countries: current issues and approaches. Proceedings of an Invited Seminar Series sponsored by the International School for Agricultural and Resource Development (ISARD). *Studies in Water and Policy Management* 8. Westview Press, Boulder and London.

Deere, CD. and Léon, M. 1997. Gender, land, water: from reform to counter-reform in Latin America. In: Merrey, D J. and Baviskar, S. (eds). Gender analysis and reform of irrigation management: concepts, cases and gaps in knowledge. *Proceedings of the Workshop on Gender and Water*. September 1997. International Water Management Institute, Colombo.

Government of Andhra Pradesh. 1997. *The Andhra Pradesh Farmers Management of Irrigation Systems Act: Act and Rules*. Department of Irrigation, Hyderabad, India.

Hossain, M. 1989. *Green Revolution in Bangladesh. Impact on growth and distribution of income*. International Food Policy and Research Institute. University Press Ltd, Dhaka, Bangladesh.

Hulsebosch, J. and Ombara, D. 1995. Towards gender balance in irrigation management: experiences in Kenya South-west Kano Project. *Irrigation and Drainage Systems* 9: 1-14.

Jazairy, I., Alamgir, M. and Panuccio, T. 1992. *The State of World Rural Poverty. An inquiry into its causes and consequences*. International Fund for Agricultural Development. Intermediate Technology Publications, London.

Mellor, JW., and Desai, GM. (eds). 1985. *Agricultural Change and Rural Poverty. Variations on a theme by Dharm Narain*. The John Hopkins University Press, Baltimore and London.

Prins, D. 1996. *La Dinámica de los Derechos de Agua en el Contexto de la Intervención 'el Proyecto Múltiple Laka Laka' en Bolivia. Un estudio sensitivo hacia el papel de la mujer en la intervención*. MSc thesis. Department of Irrigation and Soil and Water Conservation, Wageningen Agricultural University.

Projet Sensibilisation et Formation des Paysans Autour des Barrages. 1993. *Attribution des Parcelles aux Femmes dans les Périmètres en Aval des Barrages: Possibilités et limites*. Ministère de l'Agriculture et des Ressources Animales. Ouagadougou, Burkina Faso.

Quisumbing, A. 1996. Male-female differences in agricultural productivity: methodological issues and empirical evidence. *World Development* 24(10): 1579-1595.

Republic of South Africa. 1998. National Water Act. *Government Gazette* 398. 26 August 1998. No. 19182. Office of the President, Cape Town.

Sarin, M. 1996. *Joint forest management. The Haryana experience*. Environment and Development Series. Centre for Environment Education, Nehru Foundation for Development, Thaltej Takra, Ahmedabad.

Sarin, M. 1998. *Who is Gaining? Who is Losing? Gender and equity concerns in joint forest management*. Society for Promotion of Wasteland Development, New Delhi.

Seckler, D., Amarasinghe, U., Molden, D., de Silva, R. and Barger, R. 1998. *World Water Demand and Supply, 1990 to 2025: scenarios and issues*. Research Report 19. International Water Management Institute, Colombo.

Sen, AK. 1962. An aspect of Indian agriculture. *Economic Weekly*, 14 (4-6). Annual Number 323-6.

Shah, T. 1993. *Ground Water Markets and Irrigation Development. Political economy and practical policy*. Oxford University Press, Bombay.

Van Koppen, B., and Mahmud, S. 1996. *Women and Water-pumps: The impact of participation in irrigation groups on women's status*. Intermediate Technology Publications, London.

Van Koppen, B. 1998. *More Jobs Per Drop: Targeting irrigation to poor women and men*. Ph.D. Thesis Wageningen Agricultural University. Royal Tropical Institute KIT, Amsterdam.

Gatekeeper Series

1. Pesticide Hazards in the Third World: New Evidence from the Philippines. 1987. J.A. McCracken and G.R. Conway.
2. Cash Crops, Food Crops and Agricultural Sustainability. 1987. E.B. Barbier.
3. Trees as Savings and Security for the Rural Poor. 1992. Robert Chambers, Czech Conroy and Melissa Leach. (1st edition, 1988)

4-12 Out of Print

13. Crop-Livestock Interactions for Sustainable Agriculture. 1989. Wolfgang Bayer and Ann Waters-Bayer.
14. Perspectives in Soil Erosion in Africa: Whose Problem? 1989. M. Fones-Sondell.

15-16. Out of Print

17. Development Assistance and the Environment: Translating Intentions into Practice. 1989. Marianne Wenning.
18. Energy for Livelihoods: Putting People Back into Africa's Woodfuel Crisis. 1989. Robin Mearns and Gerald Leach.
19. Crop Variety Mixtures in Marginal Environments. 1990. Janice Jiggins.
20. Displaced Pastoralists and Transferred Wheat Technology in Tanzania. 1990. Charles Lane and Jules N. Pretty.
21. Teaching Threatens Sustainable Agriculture. 1990. Raymond I. Ison.
22. Microenvironments Unobserved. 1990. Robert Chambers.
23. Low Input Soil Restoration in Honduras: the Cantarranas Farmer-to-Farmer Extension Programme. 1990. Roland Bunch.
24. Rural Common Property Resources: A Growing Crisis. 1991. N.S. Jodha.
25. Participatory Education and Grassroots Development: The Case of Rural Appalachia. 1991. John Gaventa and Helen Lewis.
26. Farmer Organisations in Ecuador: Contributions to Farmer First Research and Development. 1991. A. Bebbington.
27. Indigenous Soil and Water Conservation in Africa. 1991. Reij. C.
28. Tree Products in Agroecosystems: Economic and Policy Issues. 1991. J.E.M. Arnold.
29. Designing Integrated Pest Management for Sustainable and Productive Futures. 1991. Michel P. Pimbert.
30. Plants, Genes and People: Improving the Relevance of Plant Breeding. 1991. Angelique Haugerud and Michael P. Collinson.
31. Local Institutions and Participation for Sustainable Development. 1992. Norman Uphoff.
32. The Information Drain: Obstacles to Research in Africa. 1992. Mamman Aminu Ibrahim.
33. Local Agro-Processing with Sustainable Technology: Sunflowerseed Oil in Tanzania. 1992. Eric Hyman.
34. Indigenous Soil and Water Conservation in India's Semi-Arid Tropics. 1992. John Kerr and N.K. Sanghi.
35. Prioritizing Institutional Development: A New Role for NGO Centres for Study and Development. 1992. Alan Fowler.

36. Out of Print

37. Livestock, Nutrient Cycling and Sustainable Agriculture in the West African Sahel. 1993. J.M. Powell and T.O. Williams.
38. O.K., The Data's Lousy, But It's All We've Got (Being a Critique of Conventional Methods. 1993. G. Gill.
39. Homegarden Systems: Agricultural Characteristics and Challenges. 1993. Inge D. Hoogerbrugge and Louise O. Fresco.
40. Opportunities for Expanding Water Harvesting in Sub-Saharan Africa: The Case of the Teras of Kassala. 1993. Johan A. Van Dijk and Mohamed Hassan Ahmed.

41 Out of Print

42. Community First: Landcare in Australia. 1994. Andrew Campbell.

43. From Research to Innovation: Getting the Most from Interaction with NGOs in Farming Systems Research and Extension. 1994. John Farrington and Anthony Bebbington.

44. Will Farmer Participatory Research Survive in the International Agricultural Research Centres? 1994. Sam Fujisaka.

45. Population Growth and Environmental Recovery: Policy Lessons from Kenya. 1994. Mary Tiffen, Michael Mortimore and Francis Gichuki.

46. Two Steps Back, One Step Forward: Cuba's National Policy for Alternative Agriculture. 1994. Peter Rosset and Medea Benjamin.

47. The Role of Mobility Within the Risk Management Strategies of Pastoralists and Agro-Pastoralists. 1994. Brent Swallow.

48. Participatory Agricultural Extension: Experiences from West Africa. 1995. Tom Osborn.

49. Women and Water Resources: Continued Marginalisation and New Policies. 1995. Francis Cleaver and Diane Elson.

50. New Horizons: The Economic, Social and Environmental Impacts of Participatory Watershed Development. 1995. Fiona Hinchcliffe, Irene Guijt, Jules N. Pretty and Parmesh Shah.

51. Participatory Selection of Beans in Rwanda: Results, Methods and Institutional Issues. 1995. Louise Sperling and Urs Scheidegger.

52. Trees and Trade-offs: A Stakeholder Approach to Natural Resource Management. 1995. Robin Grimble, Man-Kwun Chan, Julia Aglionby and Julian Quan.

53. A Role for Common Property Institutions in Land Redistribution Programmes in South Africa. 1995. Ben Cousins.

54. Linking Women to the Main Canal: Gender and Irrigation Management. 1995. Margreet Zwarteveen.

55. Soil Recuperation in Central America: Sustaining Innovation After Intervention. 1995. Roland Bunch and Gabinò López.

56. Through the Roadblocks: IPM and Central American Smallholders. 1996. Jeffery Bentley and Keith Andrews.

57. The Conditions for Collective Action: Land Tenure and Farmers' Groups in the Rajasthan Canal Project. 1996. Saurabh Sinha.

58. Networking for Sustainable Agriculture: Lessons from Animal Traction Development. 1996. Paul Starkey.

59. Intensification of Agriculture in Semi-Arid Areas: Lessons from the Kano Close-Settled Zone, Nigeria. 1996. Frances Harris.

60. Sustainable Agriculture: Impacts on Food Production and Food Security. 1996. Jules Pretty, John Thompson and Fiona Hinchcliffe.

61. Subsidies in Watershed Development Projects in India: Distortions and Opportunities. 1996. John M. Kerr, N.K. Sanghi and G. Sriramappa.

62. Multi-level Participatory Planning for Water Resources Development in Sri Lanka. 1996. K. Jinapala, Jeffrey D. Brewer, R. Sakthivadivel.

63. Hitting a Moving Target: Endogenous Development in Marginal European Areas. 1996. Gaston G.A. Remmers.

64. Poverty, Pluralism and Extension Practice. 1996. Ian Christoplos.

65. Conserving India's Agro-Biodiversity: Prospects and Policy Implications. 1997. Ashish Kothari.

66. Understanding Farmers' Communication Networks: Combining PRA With Agricultural Knowledge Systems Analysis. 1997. Ricardo Ramirez.

67. Markets and Modernisation: New Directions for Latin American Peasant Agriculture. 1997. Julio A. Berdegué and Germán Escobar.

68. Challenging 'Community' Definitions in Sustainable Natural Resource Management: The case of wild mushroom harvesting in the USA. 1997. Rebecca McLain and Eric Jones.

69. Process, Property and Patrons: Land Reform In Upland Thai Catchments. 1997. Roger Attwater.

70. Building Linkages for Livelihood Security in Chivi, Zimbabwe. 1997. Simon Croxton and Kudakwashe Murwira.

71. Propelling Change from the Bottom-Up: Institutional Reform in Zimbabwe. 1997. J. Hagmann, E. Chuma, M. Connolly and K. Murwira.

72. Gender is not a Sensitive Issue: Institutionalising a Gender-Oriented Participatory Approach in Siavonga, Zambia. 1997. Christiane Frischmuth.

73. A Hidden Threat to Food Production: Air Pollution and Agriculture in the Developing World. 1997. F. Marshall, Mike Ashmore and Fiona Hinchcliffe.

74. Policy Research and the Policy Process: Do the Twain ever Meet? 1998. James L. Garrett and Yassir Islam.

75. Lessons for the Large-Scale Application of Process Approaches from Sri Lanka. 1998. Richard Bond.

76. Malthus Revisited: People, Population and the Village Commons in Colombia. 1998. Juan Camilo Cardenas.

77. Bridging the Divide: Rural-Urban Interactions and Livelihood Strategies. 1998. Cecilia Tacoli.

78. Beyond the Farmer Field School: IPM and Empowerment in Indonesia. 1998. Peter A. C. Ooi.

79 The Rocky Road Towards Sustainable Livelihoods: Land Reform in Free State, South Africa. 1998. James Carnegie, Mathilda Roos, Mncedisi Madolo, Challa Moahloli and Joanne Abbot.

80 Community-based Conservation: Experiences from Zanzibar. 1998. Andrew Williams, Thabit S. Masoud and Wahira J. Othman.

81 Participatory Watershed Research and Management: Where the Shadow Falls. 1998. Robert E. Rhoades.

82 Thirty Cabbages: Greening the Agricultural 'Life Science' Industry. 1998 William T. Vorley.

83 Dimensions of Participation in Evaluation: Experiences from Zimbabwe and the Sudan. 1999. Joanne Harnmeijer, Ann Waters-Bayer and Wolfgang Bayer

84 Mad Cows and Bad Berries. 1999. David Waltner-Toews.

85. Sharing the Last Drop: Water Scarcity, Irrigation and Gendered Poverty Eradication. 1999. Barbara van Koppen.

Gatekeeper papers

can be purchased from IIED's bookshop. Contact The Bookshop, 3 Endsleigh Street, London WC1H ODD, UK.
Telephone: +44 (0)171 388 2117
Facsimile: +44 (0)171 388 2826
E-mail: bookshop@iied.org
Internet: http://www.iied.org/

For further information about the series contact:

The Sustainable Agriculture and Rural Livelihoods Programme at the same address, or e-mail: sustag@iied.org