

Irrigation-based livelihood trends in river basins: theory and policy implications for irrigation development. Accepted for publication by *Physics and Chemistry of the Earth - Elsevier*

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Abstract

This paper examines irrigation development and policy in Tanzania utilising a livelihoods and river basin perspective. On the basis of observations, the author argues that river basins theoretically exhibit a sigmoid curve of irrigation development in three stages; proto-irrigation, irrigation-momentum and river basin management. This model arises from two governing factors. Firstly, irrigation is a complex livelihood activity that, although has benefits, also has costs, risks and alternatives that integrate across many systems; farmers implicitly understand this and enter into or keep out of irrigation accordingly. In the proto-irrigation stage, irrigators are less common, and irrigation is felt to be a relatively unattractive livelihood. In the irrigation-momentum stage, irrigators are drawn very much to irrigation in providing livelihood needs. Hence, given both of these circumstances, governments should be cautious about policies that call for the need to 'provide irrigation' (when farmers may not wish to irrigate) or to further increase it (when farmers already have the means and will to do so). Second, irrigation consumes water, generating externalities. Thus if irrigation momentum proceeds to the point when water consumption directly impacts on other sectors and livelihoods, (e.g. pastoralists, downstream irrigation, the environment) decision-makers should focus not necessarily on irrigation expansion, but on water management, allocation and conflict mediation. This three-stage theoretical model reminds us to take a balanced 'livelihoods river-basin' approach that addresses real problems in each given stage of river basin development and develop policy accordingly. The paper contains a discussion on livelihood factors that affect entry into irrigation. It ends with a series of recommendations on policy; covering for example new large-scale systems; problems solving; and the use of an irrigation-river basin livelihoods approach. The recommendations here might be useful for governments and other implementing and donor agencies in Sub-Saharan Africa (where irrigation has greater potential than it currently enjoys) that are considering irrigation as policy instrument for improving rural livelihoods.

Keywords

River basins, livelihoods, policy, irrigation, water management, Tanzania

1 Introduction to current policy in Tanzania

Recently the Tanzanian Government has placed particular emphasis on the development of irrigation. Related to national interests, there has been a resurgence of interest in irrigation in Sub-Saharan Africa as an engine of rural development and food security as evidenced by increased activity of regional institutions working in these fields; SWMNet (Soil and Water Management Network), SACCAR (Southern African Centre for Co-operation in Agricultural and Natural Resources Research and Training) and IWMI (International Water Management Institute). In addition, there is renewed donor support of irrigation, (e.g. from the Danish Agency for Development Assistance (DANIDA), the Japanese International Cooperation Agency (JICA), the African Development Bank (AfDB), and the Department for International Development (DFID). There is also evidence of a greater number of analyses of irrigation, policy and the role irrigation plays in the economy (IPTRID, 1999; Schultz, 2001; IWMI, 2002; Blank et al, 2002). In Tanzanian policy, irrigation is addressed in the Poverty Reduction Strategy Process paper (PRSP), the Agricultural Sector Development Strategy (ASDS) paper (MAFS, 2001) and the Rural Development Strategy (RDS) paper (PMO, 2001). An analysis of these documents suggests that the Government should take a leading and interventionist role in irrigation development, mainly predicated on the perceived benefits of irrigation but with little recognition of the processes or stages of growth, and the costs and complexities of irrigation, or of alternative institutional mechanisms for supporting irrigation and water. The following three quotes from Section 6.7 "Land and Water Resource Utilisation and Management" (p 35) of the Agricultural Sector Development Strategy (MAFS, 2001) indicate the nature of the arguments:

“Among factors that contribute to risk in Tanzania's agriculture is the unpredictability of rainfall and the recurrence of drought and floods. Soil and water management practices must be improved in order to reduce these risks and improve the productivity and profitability of agriculture.”

"comprehensive land use maps with district-by-district details" will be prepared so that "zones with cropping and grazing potential are identified"

"a comprehensive programme for integrating soil and water conservation, rainwater harvesting and storage, irrigation and drainage will be developed by MAFS and MWLD". It will pay particular attention to ensuring long-term sustainability of water resources and making agriculture a competitive user of water in comparison with other sectors. The government will facilitate the programme's implementation by farmers through providing technical advice on these issues.”

"emphasis will be given to designing low cost and technologically appropriate irrigation and water control systems that can be managed by local communities..” (RDS; PMO, 2001; p 30)

Connected to these interests is the argument that considerable potential exists for irrigation in Tanzania. MWLD (2001) states that only 15 per cent of all suitable land is used for agriculture, and only a fraction is used for irrigation. Kalinga et al (2001, p. 6) states the position:

“the irrigation potential could be far above the estimated 1 million ha if surface and groundwater resources are combined [of which] only 15% is developed. So while we have the responsibility to make sure that the 15% area ...is operated and maintained.., we are even more indebted to make sure the remaining 85% is developed sustainably..”

The mechanisms by which this potential will be developed are outlined in the National Irrigation Development Plan, prepared in 1994 to stabilise and increase food production. They are: 1) Rehabilitation or upgrading of traditional irrigation schemes (156 of them); 2) Upgrading water harvesting technology where irrigation is not possible; 3) Develop new smallholder schemes where demand exists and conditions are appropriate. Although these remain, donor emphasis has mainly switched to numbers one and two. In 2001, JICA was asked to formulate the National Irrigation Master Plan (NIMP). The objectives appear to be a review of existing policies and lessons in order to establish new methods of delivering irrigation development. The principles of the latter are also unclear but emphasises ‘software’ rather than ‘hardware’. In other words, NIMP realises that farmers need to ‘own’ irrigation schemes – and that this will be achieved through MAFS training of participants. This is an interesting ‘top-down’ viewpoint that argues that farmers have to be trained to own irrigation schemes. Similarly;

“Thinking about non-performing irrigators especially those who have received assistance in the past and now their irrigation schemes are either abandoned or running inefficiently, one could imagine of having a law that would govern irrigation development in this country. Farmers should be responsible for the support and assistance they receive from their Government.” (Kalinga et al, 2001; 23)

Implicit in these narratives are two thrusts to irrigation development in Tanzania; one is emphasis on irrigation expansion and one is on irrigation rehabilitation and improvement (many in Tanzania hold that traditional surface irrigation in Tanzania is inefficient; figures of 15 per cent are widely quoted (Masija, 2001; MWLD, 2001). Yet because of the high costs and relatively little performance gain associated with recent rehabilitation efforts, new approaches are being formulated. This is demonstrated in the new emphasis on ‘software’ in JICA’s National Irrigation Master Plan.

However, there is a dilemma, not yet fully recognised in these documents. Irrigation requires government support but irrigation is managed and improved by farmers. Studies in Mbeya and Kilosa regions demonstrate that irrigation can rapidly expand without visible intervention by government or provision by the government of inputs (Lankford, 2002). Farmers said the increasing price of rice relative to costs was one key reason why this occurred. Where irrigation is highly managed by government, it is arguably at lower economic and water-use efficiencies (SMUWC 2000). Thus, how can ‘facilitation’ be formulated in ways that does not waste resources, that assists but does not undermine the farmers; that is pro-poor; that encourages ‘ownership’ but does not force it; that uses available water but does not promote overuse? A balanced focussed methodology is needed – something that ASPS (2000) argues for. This paper attempts to answer these questions utilising observations on irrigation uptake to theorise that policy can target different stages of irrigation livelihoods and development, and in doing so can be more focussed and effective in financial, outcome and sustainability terms.

2 Trends of irrigated livelihoods

Figure 1 presents a theoretical curve of irrigation growth in an idealised river basin. This pattern is reflected in observations made by the author in Usangu in Ruaha Basin (Figure 2) on the growth of irrigated area (Baur et al, 2000), which shows that since 1970 has area grown from about 5000 ha to about 40000 ha in 2000. Rate of uptake of irrigation was also examined by Kay (2001) who saw that, while not all countries showed increases, where it did happen “many development processes follow a classic S curve and irrigation is no exception” (p. 35). Kay goes on to infer that these curves show that many factors other than natural resources constrain development; “marketing, infrastructure, availability of fuel and spare parts; social background, labour availability, pricing policy, population density, land availability and irrigation knowledge” (p 36). Participants in a recent email-based conference organised by the World Bank (2003) also discussed the factors that induce ‘wildfire’ uptake of irrigation and came to similar conclusions as Kay. A sigmoid curve is also described by Molden et al (2001), who suggested that water development could accelerate after an initially slow growth phase. This paper uses one sector – irrigation and its parallel role in livelihood systems – rather than economic development as a whole, and argues that the curve shape and inflections allows us to craft policy that responds more closely to the stages of irrigation development.

Referring to Figure 1, in early years, irrigation is minor in extent (the proto-irrigation stage). Here livelihoods tend to focus on other activities, and irrigated crop market and services are poorly developed. Over time, either via step changes (such as the provision of a road) or via gradual growth (population expansion) irrigation becomes more important and viable. In this ‘momentum phase’ the market, livelihood and irrigated-experience system moves as one, generating a self-perpetuating interest in irrigation and support for that irrigation. In the final stage, such has been the expansion in irrigation that other sectors, which also express growing water needs, experience water shortages. This stage implies the need for constraint, water sharing, management and conflict mediation.

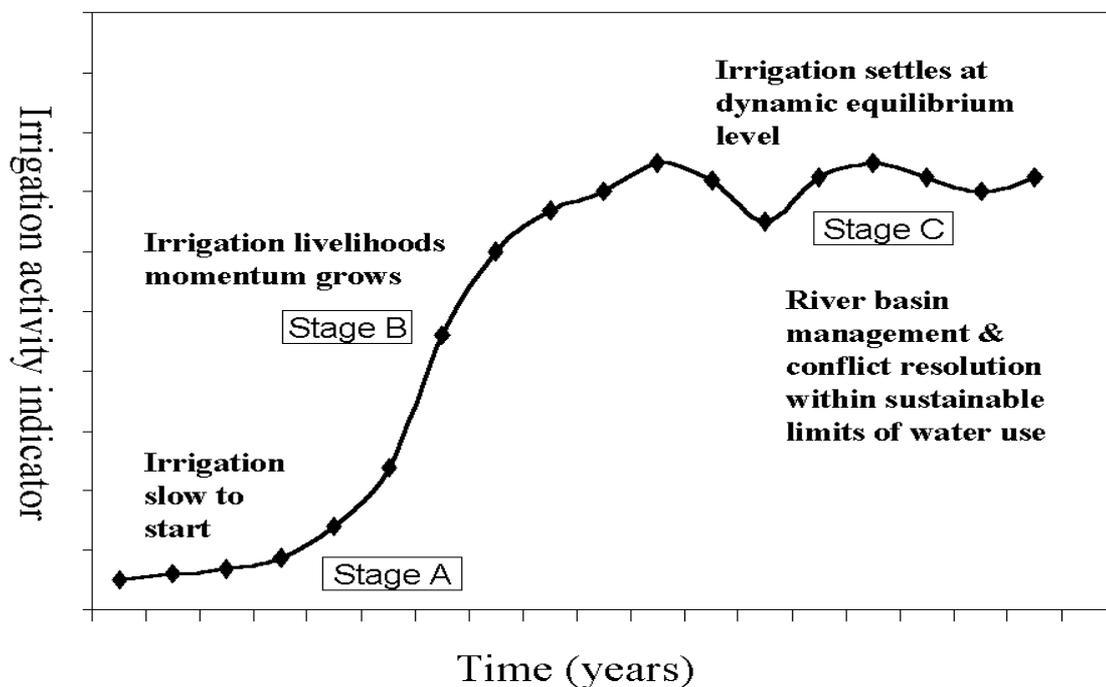


Fig. 1. Sigmoid curve of irrigated livelihoods in river basins

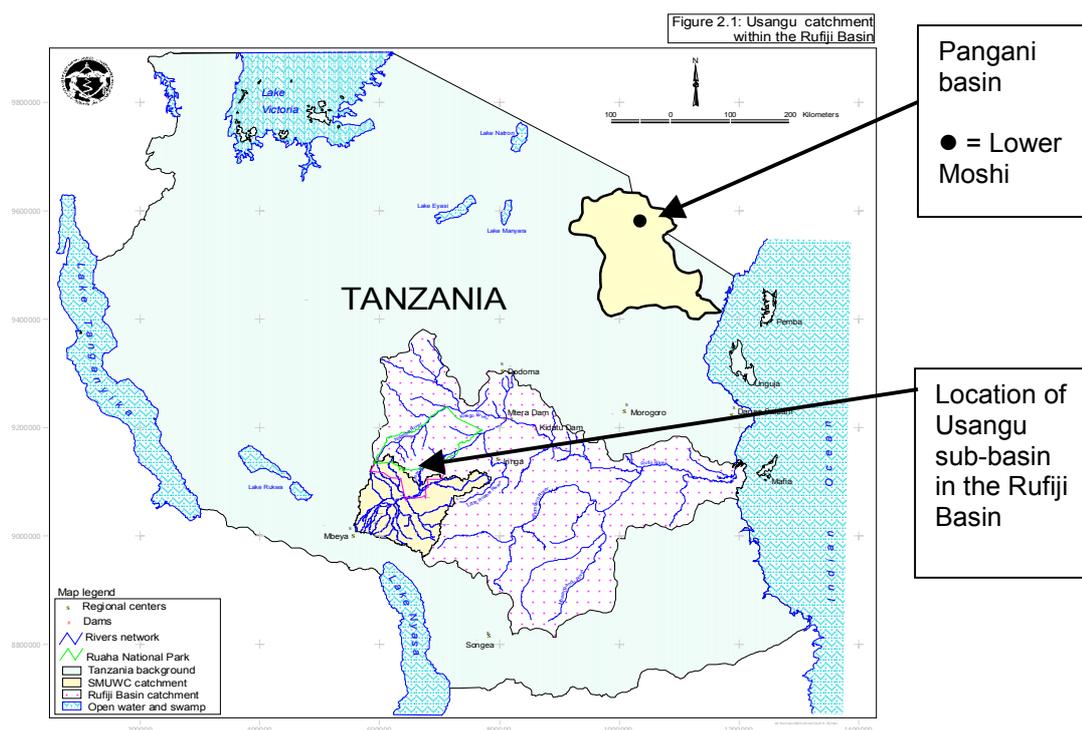


Fig. 2. Location of Ruaha and Pangani river basins in Tanzania

2.1. The benefits and attraction of irrigation

In Stage B of Figure 1 the benefits of irrigation outweigh obstacles to growth and livelihoods become irrigation-orientated. Growth occurs because irrigators enter into irrigation on the positive balance of benefits against risks and costs. Benefits of irrigation are well known. It secures crop productivity against shortfalls or breaks in rainfall (often mentioned by irrigators). Irrigated crops often enjoy a cash margin and with more water, crop productivity increases to profitable levels. Security of water improves the planning and timing of start of the cropping season and can extend the season length, possibly reducing labour calendar overlaps. Irrigation raises the number of paid jobs conducted on the land (e.g. irrigating, weeding). Lastly, it raises the value of land, attracting commerce such as renting of plots (clearly visible from increasing rents, which at Kilosa have gone from 5000 to 20-30 000 Tanzanian shillings/acre in 4-5 years; US\$1.0 = 900 Tz shilling in 2001).

Knock-on effects of these benefits can be identified. Fieldwork at Kilosa shows that farmers who had been irrigating at subsistence level chose to irrigate 'for the market', growing and selling whole-stick sugarcane and tomatoes. Here, irrigation provided a platform and exposure to home-level entrepreneurship. Farmers bought produce from others to sell. As the size of irrigation increased, so did the number of people, and importantly the number of economic transactions between active irrigating farmers, labourers, householders, landowners and service providers. Many studies support this picture of success from irrigation. DFID (1997), Shah (2000), IWMI (2002) and Van Koppen (1998) found that irrigation generated extra cash and jobs in the wider economy. Studies in Zimbabwe (CEH/IOH, date unknown) found that groundwater use in dryland areas brought considerable livelihood benefits to those villages with access to the wells. Schultz (2001) argues that food security at the national and international level is dependent these days on the contribution of irrigation. Chambers wrote cogently in 1988 on benefits of irrigation-based livelihoods found at household, regional and national levels.

2.2. The costs, risks, impacts and complexities of irrigation

The conditions, costs, risks, impacts and complexities of irrigation constitute important dimensions in Stages A, B and C of the irrigation sigmoid curve – affecting start-up, entry into and out of irrigation, and its effects on other sectors. Such problematic characteristics are not unknown. A key message of research of the last 20-30

years has been the transaction costs, institutional problems, low economic return and environmental impacts of irrigation (Bottrall, 1985; Chambers, 1988; Mazungu, 2000; Postel, 1992).

These problematic dimensions can be taken from two viewpoints; a) individual farmers; and b) cumulative effects of larger irrigation areas. From a farmer's perspective, irrigation is not always appropriate, economically feasible, required, or likely to be successful. Often, when a rather narrow window of opportunity exists because of the range of constraints and risks, farmers will tend not enter into irrigation – implied by its slow uptake in Stage A of Figure 1. Table 1 describes different elements of the total system that farmers intuitively evaluate before entering into or widening their exposure to irrigation. The table is loosely based on the sustainable livelihood framework incorporating five capitals (natural, physical, human, financial and social) and their modification by context (Ellis, 2000; Carney 1998). For example from a physical and natural point of view, too dry and there is insufficient rainfall to create large enough streams to provide secure flows for a season length of at least 120 days. Too wet and farmers utilise rainfall to grow crops. In addition, catchments need to be 'just so' having aquifers or being large enough to yield secure and sufficient water. Good soils, slopes, space and command (water to land height differential) are also required.

The social, economic and demographic context also affects farmer decisions regarding irrigation. Farmers may see no reason to invest in socially complex irrigation when rainfall meets their needs or when no market demand exists for their produce. Land ownership and tenure affects access to irrigable land. For example in Kilosa, female farmers cannot own land, but rent land – requiring difficult-to-obtain capital or credit to begin with. Often irrigation is a choice of cropping that accrues to farmers who already have sufficient assets from other jobs or by borrowing. On the whole, input costs need to be low (e.g. people are sufficiently numerous to create a pool of labour availability), cost and availability of borrowing are amenable; output prices predictably profitable (related to market demand and stability) and market transactions transparent and low in cost (e.g. minimal taxes and entry barriers). Time is required for the irrigation system to settle and evolve (perhaps at least 4 to 5 years). This also gives users a chance to teach themselves skills, to allow newcomers to bring fresh ideas and to observe cyclical patterns that can be planned for. Furthermore, irrigation is an activity that sits alongside and is compared to other livelihood and household activities. Diversified livelihoods are often a feature of such environments (Ellis, 2000). All of these activities affect water management, water productivity and time and effort spent in irrigation.

At the cumulative system level, irrigation systems grow in size or when smaller systems conglomerate, acquiring important scalar characteristics that relate to Stages B and C of Figure 1, and that need recognising by policy-makers. In Stage B growth, larger irrigation systems become function-orientated 'bread baskets' that generate considerable turnover from crop sales. For example a 500 ha rice system generates 324 million Tanzanian shillingi (\$0.35 million) from yields of 15 bags/acre sold at 18 000 tsh/bag. Such irrigation systems respond to signals of costs, prices, taxes and access to markets and in turn stimulate the development of associated market and support services. Their size generates farming-zone systems where farmers sense the connected incentive environment into which they fit, allowing further growth to occur.

However as these irrigated zones grow, so do their levels of complexity and impact. This paper skirts the notion that surface irrigation systems over 100 ha are intractable, complex and subject to livelihood risks. On the contrary, each irrigation system should be treated as being specific, individual and containing important 'stories of success'. However, the net effect of the complex nature of 'larger irrigation systems' – found in Stage C of the sigmoid curve – is to generate inter-farmer, inter-system and inter-sector competition over a scarce resource. In Usangu, in the Ruaha River Basin, it is the total area of irrigation systems (nearly 20-40 000 ha depending on water availability) that has led to problems associated with water allocation and sharing (SMUWC, 2000).

The considerable consumption of water in large-area irrigation subtracts from its use in other areas and sectors, connecting inter-dependent users in river basins through shortage. The fact that irrigation sits within a multi-sectoral, water-short environment is often omitted from planning that seeks to maximise development of 'irrigation potential' or deploy 'improvement programmes' that result in large 'modern' intakes which are more abstraction-effective. It is a key thesis of this paper that in water scarce situations (which nowadays are more common) governments and donors should be aware of other sectors and livelihoods and the need for land and water management and conflict mediation as much as irrigation development. Hence policy in Stage C of Figure 1, where irrigation is significantly present, might incorporate a problem-focussed, multi-sectoral river basin approach. Here, such an approach would purposively seek to address irrigation problems that reflect an understanding of the complexity of growth-orientated irrigation found in Stage C, rather than to impose the kinds of physical or social engineering agendas that might be superficially appear correct and 'normal' (especially for Stage B of the curve), but do not resolve important issues such as the inequity of supply within and between neighbouring irrigation systems.

Table 1. Capitals and factors affecting access to irrigation-based livelihoods

Factors affecting decisions	Less risky – less costly	More risky – constrains access
<p>NATURAL & PHYSICAL LAND Land type, slopes, command, availability, tenure, markets, prices.</p> <p>WATER & CLIMATE Equitable predictable climate and hydrology. Water availability; improved intake or pump; control of upstream users</p> <p>CROP Diseases, varieties. Rainfed maize yield</p> <p>LABOUR/ENERGY Availability own/other labour Cost of labour/energy</p>	<p>Command is present, land becomes more available, small plots made available, prices stabilise, landlords provide good contracts.</p> <p>Water is or becomes more secure, available, predictable, better distributed, less prone to disruption by upstream irrigators.</p> <p>Good maize and rice yields raise incomes, allowing farmers to invest in further assets</p> <p>Energy/labour cost benefit ratio is advantageous providing land and water.</p>	<p>Land becomes less available, or market for smaller plots becomes more competitive. Richer farmers rent more land marginalising poorer farmers. Prices increase raising risk element when borrowing money.</p> <p>Water is or becomes less secure, less available, more frequently taken by upstream irrigators, or affected by weeds, leaks etc.</p> <p>A poor rice yield due to yellow spot infestation or poor maize reduces income and can lead to debt.</p> <p>Land or water has an energy/labour cost exceeding benefits from energy/labour.</p>
<p>ECONOMIC & FINANCIAL Capital, debt, borrowing; Input & labour costs, demand; Credit & financial mgt; Market prices, stability & transaction costs/tax.</p> <p>DIVERSIFIED LIVELIHOODS E.g. Micro-enterprise, urban-rural migration, rainfed agriculture / dry season irrigation, livestock, labouring</p>	<p>Terms & cost of borrowing amenable to allow access and start-up costs. Market is accessible, predictable, easy to enter into, prices profitable.</p> <p>Other income sources become developed. Capital used to access irrigation land or vice versa - irrigation income used to build other enterprises.</p>	<p>Borrowing costs are high, terms are unfavourable, capturing or depleting other resources previously built up. Markets not accessible, prices crash, transaction costs and taxes high.</p> <p>Opportunities erode, individuals rely on few sources or permanently /temporarily migrate. Access to rainfed land decreases. Failure in one activity drains others.</p>
<p>HUMAN & SOCIAL Social cohesion & conflict resolution. Social/customary access to land.</p> <p>SKILLS & EXPERIENCE <i>Irrigation, negotiation</i></p> <p>WATER INSTITUTIONS Local village & WUA bye-laws River basin authority/laws Support by zonal irrigation office</p>	<p>Village and water user association communicate, incomers bring new ideas, farmers meet to resolve conflicts.</p> <p>New skills and techniques are acquired and deployed</p> <p>Bye-laws/legislation are understood, adopted, and used in assisting protection and or development of resources and in resolving conflicts.</p>	<p>Competition and intimidation present, poor WUA organisation, break-down in village communication, & gender or age marginalisation/ exclusion to land.</p> <p>Technical know-how does not match given infrastructure.</p> <p>Organisation breaks down, legislation is no longer utilised or known about. Policy environment erodes activities/ plans made at the household and system level.</p>

3 Discussion

The following sub-sections conclude on policy insights generated from this analysis. As a whole, these considerations apply to those ministries (e.g. Water, Agriculture) and donors engaged in water and irrigation policy. They particularly apply to medium level officers and decision-makers who are responsible for translating higher-level irrigation development rhetoric into cost-effective and targeted projects and programmes. The likely means for carrying these ideas forward revolves around initially workshops to mutually agree the detail of disbursement and support modalities – but this will not be easy and will require the assistance of the various stakeholder interest groups. The implications of this approach are a more concentrated interdisciplinary presence at a more local and decentralised level. The expense shifts from physical works, to longer-term advice and problem-solving.

3.1. Potential vs. actual irrigation

Farmers integrate across livelihood, economic, community, physical and irrigation system dynamics. A departing point for policy would be to build on what farmers are choosing to do. This contrasts with a narrative that ‘considerable irrigation potential exists which must be mapped and then fulfilled’. It is probably better to realise that farmers are more sensitive to irrigation-livelihood barriers and constraints than ‘external experts’ and that irrigation growth relates to farmer perceptions.

In addition, the rate at which irrigation does or does not respond to systemic factors varies enormously. Observations in Tanzania, and comments made by participants of the World Bank 2003 e-conference on irrigation in Africa, indicate that agricultural systems can very quickly change within the space of a few years. This too suggests that a responsive rather than a prescriptive mode of thinking is required.

This paper argues that governments should therefore tread very lightly in encouraging irrigation, understanding that localised, regional and macro-economic policies stimulate market and farming activity and affect the desire to resolve water management issues. Thus an appropriate irrigation-livelihood intervention is not necessarily the upgrading of infrastructure or establishment of WUA’s, but a reduction of farmer transaction costs (e.g. lowering rural taxes on the movement of goods) as explored by Ellis and Mdoe (2002), or control of imports of competitively low priced grain (Koning, 2002).

In other cases, it is difficult to say what creates dramatic movement into irrigation from a previous non-irrigating situation, and research is needed on the cause and significance of such cuspidal moments, a point echoed by participants in the email conference on irrigation in Sub-Saharan Africa (World Bank 2003).

3.2. Physical system improvements – livelihood mediation

In responding to and affecting these drivers and processes, farmers generally succeed with water management ‘in context’. In other words, farmers’ water management standards (by no means easy to measure) connect with a wider livelihood system. Thus in Kilosa, the change from simple rice flooding to basin irrigation which happened in the early 1990’s heralded higher yields, wider sharing of the available water, increased land rentals and a much greater interest in rice cultivation as a basis for income generation. In addition, these livelihood system conditions mediate the success of formal irrigation intervention. If encouraging conditions exist to promote irrigation expansion or improvement, external intervention is either probably not required or is required in ways that lever local capabilities. If conditions are deleterious to irrigation-based livelihoods, then interventions are unlikely to be physically, economically and institutionally sustainable. For example, markets generate comparative price incentives for farmers to improve water management, underlain by their investments in infrastructure. Thus farmers decide to line or rebuild canals when the value of doing so outweighs the costs of not doing so. Examples of these decisions are found in Usangu; farmers did not upgrade an intake but did rebuild a canal wall that has collapsed. In the former, the water supply was not under threat, whereas in the latter it was. An engineer might think that both intake and canal need improving but it is the argument of this paper that farmers are better placed than governments to decide these detailed system-level investment priorities. This farmer-led perspective suggests that support is needed, one that is more highly attuned to farmer perspectives; perhaps using a regional or district-level approach and longer timeframes than usually employed.

3.3. An irrigation-river basin livelihoods approach

Fully realising irrigation potential is risky because irrigation consumes water. The livelihoods approach in its original form with its five capitals (Carney, 1998) would seek to maximise per capita agricultural use at the local level, while a river basin approach balances that against ‘other-sector’ use of water. The danger is that local emphasis without a catchment perspective might require expensive re-tuning programmes to reconcile upstream/downstream water use. For example, if irrigation intakes are to be built, they could be constructed in ways that explicitly share water between upstream and downstream demands. Proportional or castellated weirs are applicable (Lankford, 2001). From a policy implementation point of view there is a natural tension between seeking to alleviate poverty via irrigation programmes and seeking to conserve or generate other values by using water elsewhere. In solving these issues, decision-makers should be reminded of the critical role that small amounts of freshwater play in providing lifeline needs; the irrigation expansion rhetoric may be unhelpful if these lifeline needs are not initially or also addressed. This balance further obligates local government departments or other service providers to rapidly respond to the effects of policy implementation.

3.4. New large-scale systems

In certain circumstances, donors and governments may have to provide the capital for major works beyond the reach of poor farmers. Here lies the pluralistic nature of the support required; caution with small-scale irrigation because farmers are usually able to devise the necessary infrastructure themselves, but significant support when new irrigation requires large-scale infrastructure beyond the scope of farmers. These would by their nature not result in small-scale works, but in larger-scale developments of smallholder irrigation. Such systems could be located on incised larger rivers where downstream needs were minor or accounted for. 'Large-scale' is a proposition that is currently out of favour with donors, who appear to lack the confidence to establish such systems. One solution might be to construct the head works only and let farmers develop the canal system. In doing so, farmers generate skills in organising labour to construct the system and incur themselves to claims on future water schedules. Pro-poor elements could be designed into this approach, e.g. land settlement could part focus on plots for women, young and the poorest (Koopman et al, 2001) Since the interest in this irrigation mode probably already exists within agricultural ministries, the onus for revisiting the benefits and deployment of large-scale systems lies with donors and the irrigation specialist community.

3.5. Cross-cutting problem-solving approaches

Rather than generically tackling irrigation, one way might be to identify problems that are more locally-relevant but pressing. For example, in Usangu the farms belonging to the parastatal NAFCO could be re-distributed to poor families as an example of irrigation management transfer. Although this is happening informally via private rental agreements, it could be formalised to meet desirable pro-poor outcomes. If conducted at the rate of 0.5 ha per family, this could provide for more than 6000 families. Yet, this type of project lies outside of the normal 'improvement' programmes found in Tanzania. This kind of strategy usually cuts across a number of government departments and their respective policies and may encounter resistance from those seeking to maximise profit from the sale of parastatal assets to the private sector. One institutional mechanism theoretically suited to this localised approach is the 'river basin office', charged with drawing up basin-specific priorities. Yet in Tanzania, the ministerial lacunae between agriculture (irrigation) and water (river basin offices) helped keep this cross-departmental problem from being properly addressed.

3.6. Conflict mediation as route to improve water management

Conflict mediation applies to both the river basin and sub-catchment scale, but also, importantly to the irrigation system. River basin institutions and appropriate intake design are part of the former. However, irrigation has special significance because, although government and donor institutions should be cautious about the need to roll out irrigation, there is a case for their involvement and facilitation of improved water management. However, rather than this occurring because engineers dictate that irrigation efficiency is 'low', it is better framed as a response to requests by farmers who genuinely identify and verbalise water distribution problems. Such an approach has important dimensions of being problem-focussed, service-orientated, responsive and demand led. Various activities are envisaged; partnership engineering, facilitation sessions, game and role-playing, farmer training, problem ranking and participatory institutional analysis. It is likely that such an approach will develop new skills amongst engineers whose training tend to focus on conventional methodologies. The responsibility for instigating such capacity reform probably lies with the international irrigation community, although it is not clear that within this institutional group there is general agreement on the objectives and modalities of agricultural water management.

4 Conclusions

Several issues stand out from this analysis of sigmoid development curves of irrigation. Firstly, farmers choose to irrigate depending on a variety of issues, and move into irrigation quickly, investing their own resources when circumstances suit. Secondly, in under-irrigating areas, experts could consider what kind of enabling environment encourages farmers to start irrigating, and while this may still not provide capital-intensive schemes, it would attract farmers to invest in expanding systems. Thirdly, the 'potential irrigation' and 'improvement' narrative of the strategy papers misses more pressing issues of a responsive mode of reacting, problem-solving, or providing conflict mediation in existing irrigated areas where the demand for irrigation is ever present. There are dangers in believing the Government can 'roll out' irrigation expansion without risks. Indeed a lack of contextual analysis could be blamed for projects in places where smaller systems were already competing over water (e.g. Lower Moshi in the Pangani Basin). Fourthly, the cusps and rates of change surrounding these periods suggest unusual shifts in irrigator perspectives. Research of these moments of rapid

uptake of a technology by farmers would further benefit our understanding of responsive demand-led policy. In summary, this paper has strong parallels with arguments made by Guijt and Thompson (1994):

“An environmental and socio-economic analysis of irrigated agriculture challenges us to come to terms with the complexity of local livelihood strategies in diverse and risk-prone environments”. (p. 295)

“Assumptions made by engineers and planners about social and economic realities and about the likely performance of systems reflect a limited perspective on landscapes and livelihoods which is often at odds with local realities” (p. 307)

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