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Water for Food Security for the Poor

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Introduction

During the last 40 years, the growth in global food production has outpaced population growth. Cereal prices in real terms in the global markets have been falling. Apparently there is an abundance of food in the world. Nations or households with the means to buy food generally have no problem acquiring all they need. Yet, the stark reality is that in virtually every country there are communities and groups of people who suffer from endemic undernourishment and lead lives of persistent food insecurity and want. According to a recent Food and Agriculture Organization estimate, there are about 800 million people in the world who suffer from inadequate diets. The majority of them (about 770 million) live in developing countries. The prevalence of undernourishment is more pronounced in Sub-Saharan African and South Asian countries where some 28% and 24%, respectively, of the population do not have a secure access to a minimum quantity of food to sustain an active and healthy life. These are also regions with the highest incidence of chronic poverty.

These countries are facing severe problems of hunger, malnutrition, rural unemployment, land degradation, population explosion, and rural migration to overcrowded urban centers. In spite of economic reforms, a recent World Bank study acknowledges that structural adjustment programs in Sub-Saharan Africa are not generating a sustainable supply response in agriculture, particularly from smallholders (Donovan 1996). In some instances, the escalation of fertilizer prices, the failure of public sector credit systems for smallholders and problems in marketing services have created new challenges for smallholders. It follows, therefore, that enhancing the capacity of public sector institutions to spearhead more rapid agricultural transformation for smallholders is a matter for urgent attention. Moreover, the majority of these countries are still rural, and it follows that the focus should be on smallholders to ensure that the benefits of development are broadly distributed. In the developing and transition countries, almost 1.2 billion people, or about one out of four, live on less than \$1 per day. Most of these people, including children, work long hours at physically demanding jobs just to survive.

An FAO study on the cost of hunger and malnutrition to the national economy showed that "Eliminating, or at least significantly reducing, poverty in a country will have an important impact on the growth rate of its GDP. Increasing the

daily energy supply to 2,770 kcal ppd in a sample of countries that were below that level could increase the average annual GDP growth rate by some 0.8%. This gives an idea of the magnitude of cumulative growth losses in countries suffering from malnutrition.”

A study in the US has shown the existence of the relationship between food insufficiency and school functioning. The results indicated that intermittent experiences of food insecurity and hunger were associated with impaired school performance, tardiness, absenteeism, and higher levels of hyperactivity in children. Children from food-insecure households are more likely to show behavioral, emotional, and academic problems on standardized measures of psychosocial function.

Understanding the Food Security Issue

Poverty, food insecurity, and vulnerability are closely related concepts or phenomena and therefore their meanings have to be clarified at the outset. Food security, food insecurity, and vulnerability are aspects or correlates of poverty. *Food security* is a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for any active and healthy life. Food security includes at a minimum: the ready availability of nutritionally adequate and safe foods and an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies). Food security is an essential element of overall human well-being.

Food insecurity, the opposite of food security, is a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Food insecurity may be chronic, seasonal or transitory. Food-insecure people are those individuals whose food intake falls below their minimum calorie (energy) requirements, as well as those who exhibit physical symptoms caused by energy and nutrient deficiencies resulting from an inadequate or unbalanced diet or from the body's inability to use food effectively because of infection or disease. An alternative view would define the concept of food insecurity as referring only to the consequence of inadequate consumption of nutritious food, considering the physiological utilization of food by the body as being within the domain of nutrition and health.

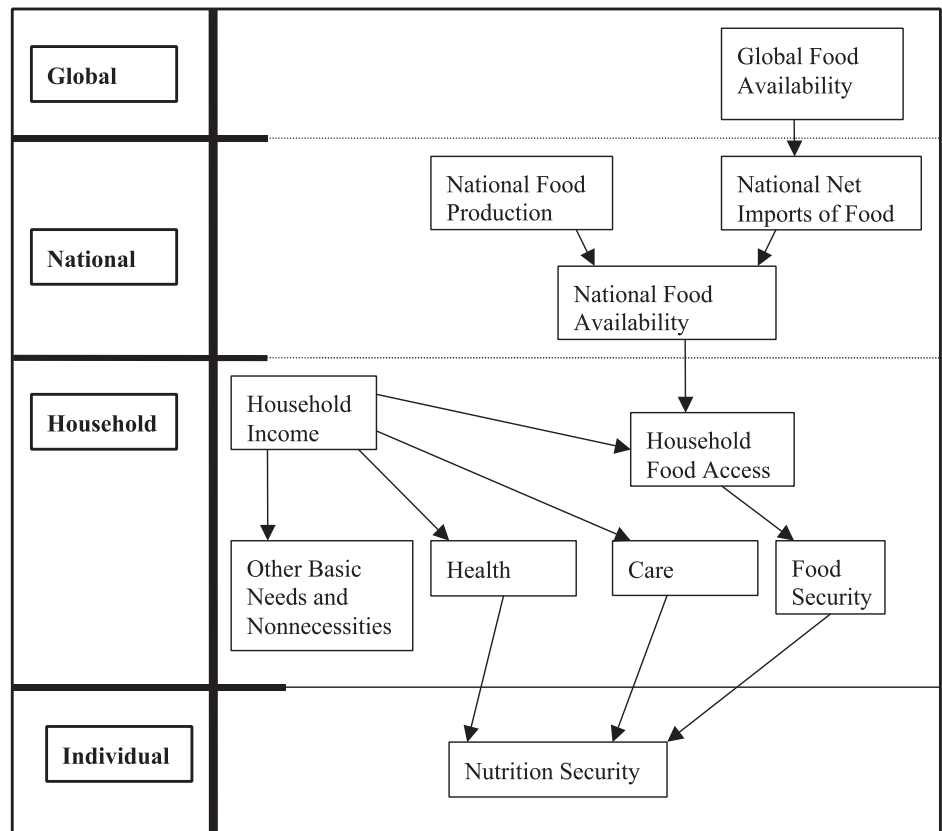
Vulnerability is the presence of factors that place people at risk of becoming food insecure or malnourished, including those factors that affect their ability to cope. A related concept is what is known as a vulnerable group—a group of people with the common characteristic, of either being food insecure or at high risk of becoming food insecure. The degree of vulnerability of individuals, households, or groups of people is determined by their exposure to the risk factors and their ability to cope with or withstand stressful situations.

The concept of food security has evolved over a period of time. Until the early 1970s, adequate availability of food-grains at the national level was considered a good measure of food security. Emphasis was placed on food self-sufficiency at

the national level, principally through domestic production. Food insecurity is no longer considered as a problem of the physical inadequacy of food supplies. The inability of poor countries, poor families, and poor individuals to acquire sufficient quantities of food from existing supplies either due to low purchasing power or defects in the food distribution systems limits a person's or household's entitlements to food supplies, especially among the poorest of the poor.

Food security can be viewed at four levels: the global, national, household, and individual levels. Figure 1 gives a widely agreed upon conceptual framework for food security. It shows how national food availability works through food security to ultimately influence nutritional security, which is adequate nutritional status on a sustainable basis. As is well known, enough food available at a national level is only a necessary condition for households to have access to food but it is not a sufficient condition. Households must also have the necessary resources to acquire that food and at the same time meet other basic needs. Finally, food security works through people's dietary intakes to influence their nutritional security. But food security is not sufficient for them to achieve nutritional security. They also need adequate care and a healthy living environment to be able to absorb the nutrients in food and thus use it in their everyday lives.

Figure 1. Framework for Understanding Food Security



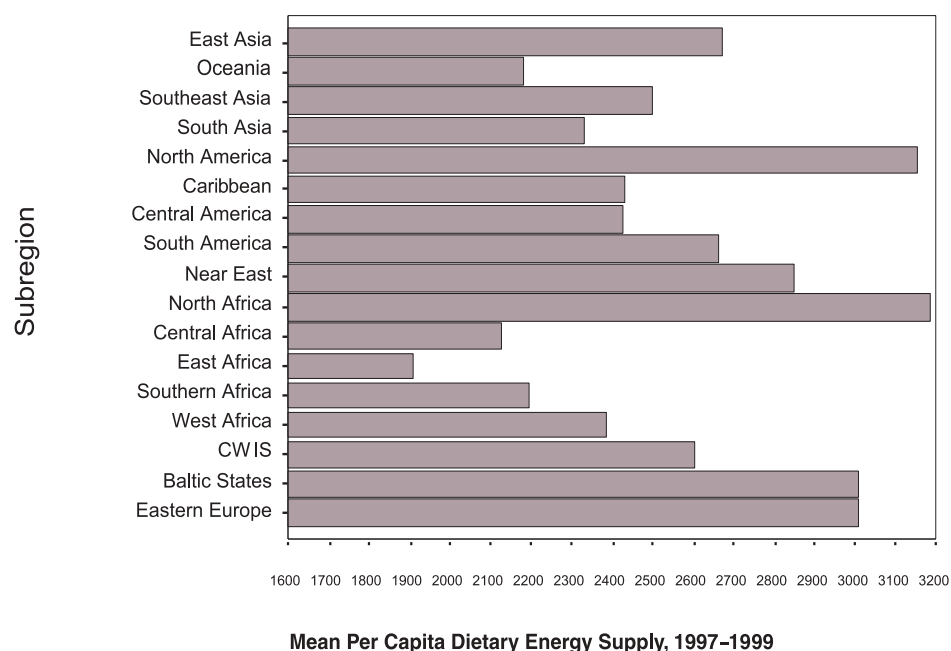
Sources: Adopted from FAO and World Bank food security related publications.

Prevalence and Depth of Food Security: The Global Context

The most commonly accepted food security indicators are all related to consumption, nutrition, and health status. Average per person dietary energy supply (DES) and percentage of population undernourished are usually used as indicators of consumption status, while consumption of cereals, roots, and tubers as percentage of DES is used as an indicator of the degree of dietary dependence on the major staple and hence the average quality of the diet for a national population. The percentage of population undernourished provides information on the number of people within a population whose dietary energy intake lies below their minimum requirements. Information on these indicators was solicited for 126 developing countries plus countries in transition from the FAO web site. For convenience, these countries were grouped into 5 regions and 17 subregions mainly based on geographic proximity.

The per capita food availability of the subregions is depicted in Figure 2. The lowest per capita food availability is observed in Africa, especially in the East, Central, and Southern African countries. In the continent of Asia, South Asian countries have the lowest per capita food availability.

Figure 2. Comparison of Per Capita Energy Supply by Subregion



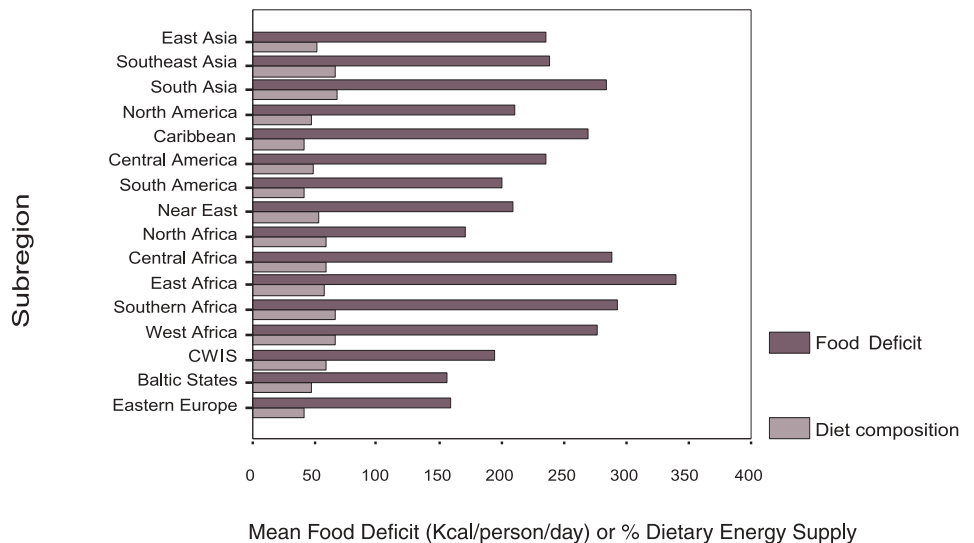
Similar patterns are observed regarding mean food deficit of the undernourished and the nutritional quality as indicated by the proportion of food staples in the total DES (Figure 3).

Generally speaking, the prevalence of food insecurity is most acute in countries or regions where the percentage of irrigated land is least. For instance, in Africa irrigated land represents, on average, less than 8% of the arable land, with large differences between countries. Irrigated land percentages are highest in the Northern region (99% in Egypt) and lowest in the Central region (0.2% in Democratic Republic of the Congo). The average for Sub-Saharan Africa is less

than 4%. Yields of irrigated land are about 2.2 times higher than from rainfed land (FAO 1996).

The African continent has a centuries-long history of rainfall fluctuations with droughts of varying lengths and intensities, which continues to the present. The Sahel, the Horn of Africa, and the countries around the Kalahari Desert are characterized by high inter-annual and intra-seasonal rainfall variability. Good and bad years do not occur singly or at random but tend to be grouped. This has important implications for food security as food and water may need to be stored over a period of several poor years.

Figure 3. Comparison of Mean Food Deficit of the Undernourished and Dietary Quality by Subregion



Food insecurity is a complex phenomenon, attributable to a range of factors that vary in importance across regions, countries, and social groups, as well as over time. These factors include the socioeconomic and political environment such as globalization, structural adjustment programs, governance, etc., the performance of the food economy, health and nutrition, armed conflict and civil strife and access to land and productive resources, and natural calamities such as drought and flood damages. Additional issues may arise due to disparities in intra-household allocation of food and gender discrimination (see Pitt, Rosenzweig, and Hassan 1990, for Bangladesh).

Many developing countries have been facing unusually adverse climatic conditions, together with the negative economic impact of the financial crisis that erupted in 1997, declining prices of several of their major commodity exports, and in a number of cases, political instability and conflicts. Food supply disruptions, associated with these problems, have led to the outbreak or persistence of serious food emergency situations in a large number of countries. On the other hand, the chronic inability of smallholder farmers to have their economic interests articulated in the political process is cause for serious concern particularly in dual agrarian societies. The lack of political wisdom to give priority to

agriculture, particularly in terms of commitment to the transformation of smallholder agriculture, is the most serious post-independence error of judgment by African nations.

Key Approaches to Addressing the Problem

In most low-income developing countries, particularly in South Asia and Africa, non-agriculture sectors, specifically services and industrial sectors, are expanding gradually at a slow pace and agriculture is still considered as engine of growth. At the present level of overall socioeconomic development, agriculture development is seen as the most effective way to achieve improved incomes and to ensure food security not only at the national level, but more importantly, for regional, local, and household level, food security, and poverty reduction. The poor with tiny landholdings and the landless will continue to depend on agriculture for food, employment, and incomes required for nonfood and basic needs. Therefore, improving agriculture and enhancing food production will remain a key strategy for food security and poverty reduction in most of the low-income countries. Improved access to food of the poor through their own increased production or through their enhanced purchasing power and economic ability to buy food would be the most effective way to move people out of food poverty.

The approaches and actions to tackle the problem of food insecurity may be categorized into four major groups. These are *the growth-oriented approaches, the equity oriented approaches, the institutional approaches, and the synergy of the three*. From the viewpoint of growth-oriented programs, the development of the agriculture sector is inevitable, since the highest incidence and severity of poverty are found in rural areas, and most of the poor are mainly engaged in the agriculture sector. Agricultural development does not only play an important role for the overall economic growth, but also its indirect effects on employment and benefits to the poor are acknowledged.

The World Bank studies in India show that primary sector growth reduces both urban and rural poverty, whereas tertiary sector growth reduces mainly urban poverty. Further, the benefits of farm sector growth are not confined to those households located near the poverty line but go down to those located deeper below the poverty line, that is, growth benefits the chronically poor. Growth has benefited Indian poor in both relative and absolute terms (Datt and Ravallion 1996; 2002). An empirical analysis of 92 countries spanning 4 decades confirms that growth benefits the poorest of the poor (Dollar and Kraay 2002). Irz et al. (2001) found that for a sample of 40 countries, the elasticity of poverty rate to agricultural productivity growth rate is about 1%, meaning that the percentage of those living below the \$1 a day poverty line fell by about 1% for every percentage point increase in agricultural productivity. Taking the case of South Africa, Khan (1999) shows that the poverty reduction effects of agricultural growth multipliers are 0.146 for incidence, 0.163 for depth, and 0.196 for severity of poverty.

From the equity perspective, it is noted that growth per se is not sufficient to reduce poverty, unless its benefits are widely distributed through public provision and strengthening of social services such as education, health, nutrition, and family planning. Such programs also offer the possibility of multiple benefits. Lower productivity may be the result of undernutrition. A number of studies have shown

that health and food consumption/security directly affect productivity and wage rates in low-income settings (Strauss 1986; Deolalikar 1988; Behrman and Deolalikar 1989). In Sierra Leone, for instance, a 10% increase in per capita calorie availability increased farm output by 3.4%. This effect was stronger for households with an average per capita energy intake of 1,500 calories per day (Strauss 1986). Lipton and Maxwell (1992: 12–13) warned that there are many people who are unable to escape poverty because their supply of labor is limited (in quantity and quality) by their health, nutrition, or education. For these people, social services can also supply safety nets in the form of income transfers, consumption subsidies, and public works or emergency relief. Such social security can indirectly help growth by enabling poor people to take risks. In the Asian context, Haan and Lipton (1998) warn that poor countries will not maintain earlier rates of poverty reduction without explicit redistribution. In a similar vein, Srinivasan (2000) advocates a development strategy that generates “rapid and widely shared growth,” and emphasizes investments in education and health, to help ensure that human and physical capitals are efficiently utilized for poverty reduction.

It is clear that there are two important fronts for public intervention that can be identified. One involves fostering the conditions for pro-poor growth, particularly in providing broad access to the necessary physical and human assets, including the infrastructure. The other entails helping those who cannot participate fully in sharing the benefits of such growth, or those who do so with continued exposure to unacceptable risks. Providing a basic infrastructure, services, and maintenance of basic amenities to several rural areas are a universal function of the state. Often these are outside the power of local communities to command and install, or of the market to provide them.

From the institutional point of view, *institutional change* is a precondition for the eradication of rural poverty and food insecurity. The experience of the past decade of development shows that unfavorable institutional environments restrain the ability of the poor to participate and share in the benefits from the fruits of development.

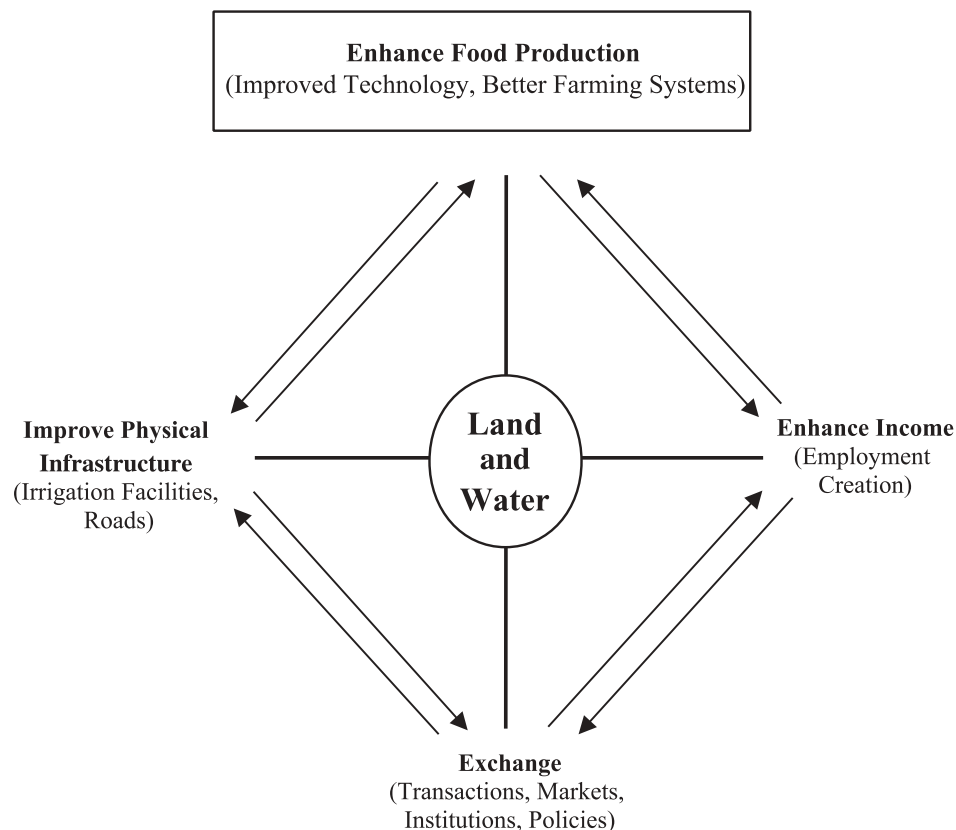
Still there are some who argue that the synergy of the above three elements is of paramount importance in achieving development goals and alleviating food insecurity. Programs and interventions in rural development should not only take place in the field of production or growth, but also be extended to the field of consumption or equity, as well as in the inclusion of institutional or organizational programs.

In order to achieve success, strategies to eliminate food insecurity have to tackle these underlying causes by combining the efforts of those who work in diverse sectors such as agriculture, nutrition, health, education, social welfare, economics, public works, and the environment. At the national level, this means that different ministries or line departments need to combine their complementary skills and efforts in order to design and implement integrated cross-sectoral initiatives which must interact and be coordinated at the policy level. At the international level, a range of specialized agencies, development organizations, and funding agencies must work together as partners in a common effort.

The causes of food insecurity suggest that four major interventions can be used to improve food security. These are illustrated in Figure 4. The first influences

food security by enhanced agricultural production. The small farm sector must be the center of this effort. A number of studies demonstrate that smallholdings generally achieve better energy ratios than larger ones (e.g., the ratio of energy available in the crop produced, to the energy required to produce it). Smallholder family farms also offer greater impact on alleviating poverty, hunger, and unemployment. In addition, smallholder farmers who use irrigation generally achieve much higher incomes than their rainfed counterparts.

Figure 4. Interventions for Improving Food Security

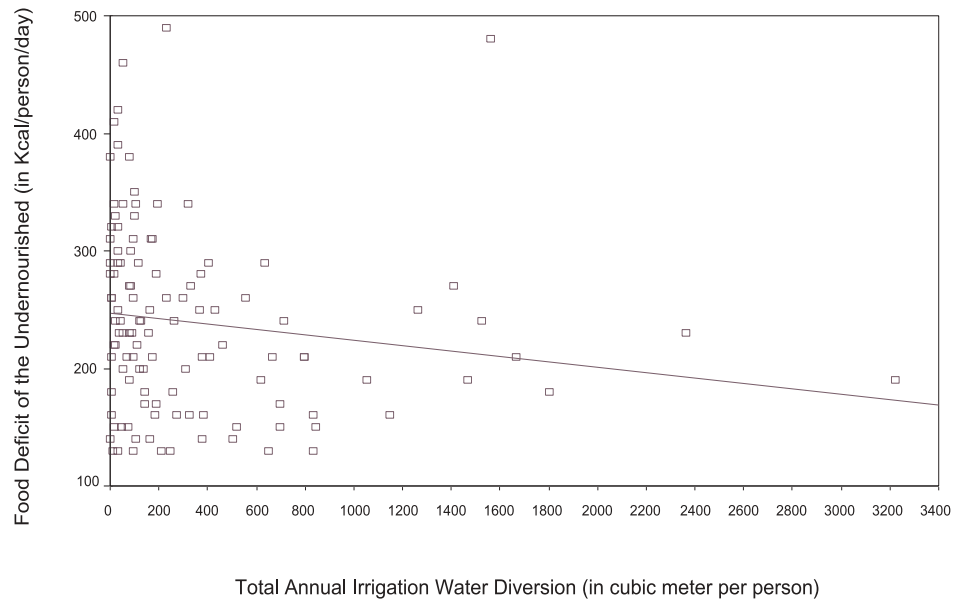


The second intervention is aimed at improving the purchasing power of the poor by generating more employment opportunities and empowering the poor. The third intervention is to facilitate exchange of goods and services by the poor. This involves creating an enabling environment for the poor to engage in market transactions as sellers and buyers of goods and services through effective policies and institutions. The fourth intervention involves infrastructure development such as the provision of irrigation facilities, development of the rural roads to access markets, and provision of electricity.

Agricultural water resources development has been a key component of each of the four areas of interventions. A scatter diagram of the relationship between irrigation water development and food security is depicted in Figure 5 and Figure 6. Figure 5 shows the relationship between annual irrigation water diversion in cubic meter per person and food deficit of the undernourished for 126 developing

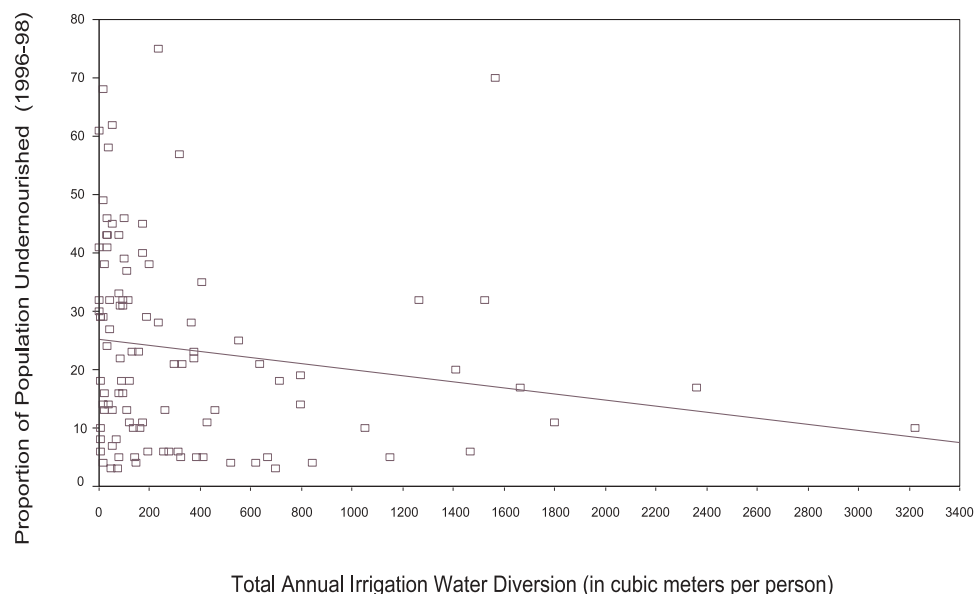
countries and countries in transition. One can vividly see that as per capita annual irrigation water increases, the level of the food deficit of the undernourished decreases substantially. However, one can also see that certain countries achieve the lowest deficit irrespective of the level of irrigation water diversion. This shows the differential economic development among developing countries and variations in their structure of economy. Figure 6 also depicts a similar trend, i.e., as the annual total irrigation water diversion per person increases the proportion of population undernourished decreases. A recent World Bank study in Viet Nam on irrigation investment showed that even undifferentiated expansion of irrigation schemes (without targeting the food insecure and vulnerable group) would be redistributive—having higher proportionate gain to the poorer households. However, the study also concluded that targeting irrigation expansion to the households with smallest per capita land produces the most progressive incidence of gains as well as the largest absolute benefit to the poor, given the right level of education (van de Walle et al. 1995). Jimenez (1995) summarizes 58 studies from various countries and shows that 1% improvement in irrigation, rural roads, or the density of regional roads creates 1.62%, 0.26%, and 0.21% improvement in agricultural productivity.

Figure 5. Relationship between Irrigation Development and Food Deficit of the Undernourished



The substantial investments in irrigation development facilitated the green revolution and the gains in cereal grain production. The increased production and the lower cereal prices obviously benefited the poor. Irrigation development also enhanced farm incomes and increased employment opportunities, both on—and off-farm, providing entitlement or purchasing power for the poor. For landless laborers, the increased cropping intensity in the irrigated farming areas provided the greatest opportunities for employment. Storage dam construction and other innovations in hydrology such as more effective and cost-effective ways of harnessing or accessing and using water, especially groundwater, have enabled

Figure 6. Relationship Between Irrigation Water Development and Food Security



dry season cropping of land which were usually left fallow, thereby increasing household food supply. In the following sections, these views are further tested by drawing on the experience of irrigation investments in Sri Lanka, Pakistan, and India.

In Sri Lanka, irrigation development has been a major instrument used by the government in its attempts to enhance food security and eradicate poverty for over 5 decades. Substantial investments have been made to establish irrigated land settlement schemes in the dry zone of the country and to resettle poor landless families from the overcrowded wet zone and provide them with an opportunity to enhance their livelihoods through irrigated farming. By 1998, some 328,000 ha of land had been developed under irrigated settlements and about 200,000 poor families had been resettled.

The irrigated land settlement policy of the government has been a multi-pronged strategy. Irrigation development was coupled with the development of other physical and social infrastructure. Many of the settlement schemes are now prosperous agricultural areas and form the cornerstones of agricultural production in Sri Lanka. The irrigated settlements of Sri Lanka can be regarded as a good example of water resources development against poverty.

Under Sri Lanka's resettlement policy, the focus has been on directly targeting the poor. One such scheme, an example of a large irrigation system that was developed targeting the poor, is located in the Walawe Ganga Basin in southern Sri Lanka. Presently, about 17,400 ha of irrigated land provide direct and indirect support to 34,000 families settled in the scheme (including families encroaching lands in the area). A large number of these families have been relocated from other districts for settlement in the basin. Each settler is given a parcel of 1–2 ha for paddy and other field crop cultivation, in addition to land allotment for homesteads. Land and water resources development in the area is truly a pro-poor intervention.

A recent study by the International Water Management Institute (IWMI) assesses the poverty reduction impacts of the development of irrigation infrastructure and access to irrigation water in the scheme. The study is based on comparisons of irrigated areas with rainfed areas, under similar agro-climatic conditions, with in-depth analysis of incidence, depth and severity of poverty using both monetary and nonmonetary indicators of poverty. The study uses field level panel data recently collected through comprehensive field surveys, and participatory poverty assessments. The study provides strong empirical evidence that irrigation does have a positive impact on food security and poverty reduction. Areas without access to irrigation infrastructure and inadequate water supplies have the highest incidence, depth and severity of income/monetary poverty. Areas with access to irrigation infrastructure generally have lower levels of chronic poverty and a higher proportion of non-poor. Average annual household food expenditures in areas with and without access to irrigation are found to be \$448 and \$343, respectively.

The analysis of nonmonetary indicators of poverty such as dependency ratio, mortality rate of children below 5 years, housing, education, and other facilities, clearly demonstrates that households with access to irrigation are socioeconomically better-off than those without access to irrigation. The availability of water is critical to obtaining regular incomes and even in irrigated areas with access to irrigation infrastructure, the lack of water could result in lower incomes. Factors such as adequate water, marketing facilities, and diversified cropping can help to reinforce and boost the benefits from irrigation infrastructure.

The study also compares the impacts of irrigation on poverty in Sri Lanka with those in Upper Indus Basin Pakistan. In Pakistan, land distribution is highly skewed leading to significant inequity in distribution of benefits of water resources, and most of the water resources were developed for general socioeconomic uplift rather than specifically targeted to the poor. Consequently, the impacts of most agricultural water-related recent interventions (such as of on-farm water management programs) on food security and poverty of the real poor has been only marginal.

Many irrigated areas in large-scale systems, particularly in India and Pakistan, continue to remain home to a large number of the poor. This is partly due to low productivity resulting from lack of access to water, even within the established systems, particularly in downstream areas. Table 2 presents results from a recent detailed study on wheat productivity in selected systems in India and Pakistan. In India, wheat yields consistently decrease toward tail ends as access to water decreases. A similar pattern is observed in the studied systems in Pakistan, except in areas where groundwater quality is good (such as the Khadir system).

Lower productivity at tail ends translates into lower farm incomes, resulting in higher incidence of poverty. The study concludes that wheat production is highly profitable with only canal water use, and least profitable with the sole use of poor quality groundwater. The study presents alternative scenarios on impacts of water use from two sources on the socioeconomics of wheat production, and it is suggested that adopting effective reallocation of canal water at the distributary level can increase overall gains from wheat production. Much of the gains from canal water reallocation will be achieved in reaches where groundwater is of poorer quality (mainly tail ends of irrigation systems). The study concludes

Table 1. Average Wheat Yield (t/ha) of Different Watercourses in India and Pakistan, 2000–2001

India						
Location (Distributary/ Watercourse)	Batta			Rohera		
	Head	Middle	Tail	Head	Middle	Tail
Head	4.81	4.73	4.42	4.92	4.83	4.28
Middle	4.56	4.42	4.22	4.89	4.79	3.98
Tail	4.35	4.31	3.72	4.91	4.67	3.55
Average	4.57	4.49	4.12	4.91	4.76	4.04
Pakistan						
	Lalian			Khadir		
Head	5.18	4.02	2.96	4.56	3.00	4.51
Middle	4.92	3.31	3.01	3.32	3.51	4.57
Tail	4.79	4.5	3.59	4.22	3.62	4.69
Average	4.95	3.92	3.19	4.03	3.37	4.59

Based on crop cutting experiment, 2000–2001.

Source: Intizar Hussain, R. Sakthivadivel; Upali Amarasinghe, M. Mudasser, and David Molden. 2003. *Land and Water Productivity of Wheat in the Western Indo-Gangetic Plains of India and Pakistan: A Comparative Analysis*, IWMI Research Report 65. Colombo: IWMI.

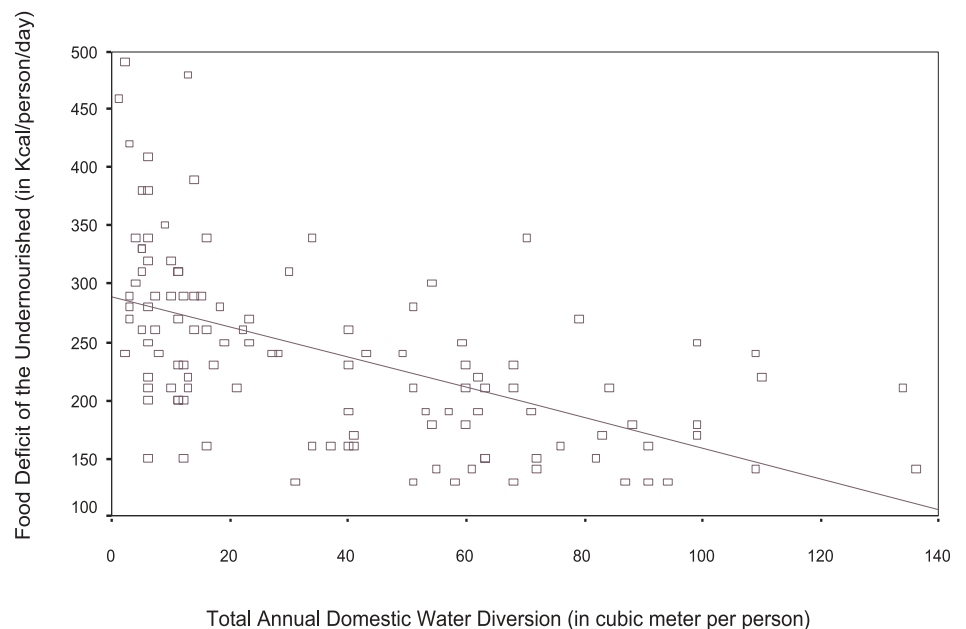
that the proposed canal water reallocation under conditions of water scarcity would lead to an increase in economic productivity, environmental sustainability, (by reducing further degradation of land and water resources), and social equity with significant impacts on poverty at tail ends.

On small-scale irrigation, recent research work by IWMI suggests that small-scale technologies have tremendous potential for improving the livelihoods of the poor in eastern India, the Nepal Terai and Bangladesh (the heartland of the Ganga-Brahmaputra-Meghna basin), South Asia's so-called *poverty square*. Underlying this region, where 500 million of the world's poorest people, with tiny landholdings, is one of the world's finest groundwater resources, available at a depth of 1.5–3.5 meters. Here they employ an example of such technologies—the treadle pump, which is truly a pro-poor device. It is cheap, with a cost of about \$12–30, easy to install, operate, and maintain, and has no fuel costs. It has higher output than a hand pump and other manual devices. Treadle pump use results in increased land use intensity, and average yield tends to be much higher than yields obtained by farmers using diesel pumps or other manual devices. The income impact of the treadle pump varies across households and regions, with an average increase of

\$100 per year in net annual income. The study indicates that the “treadle pump technology has the potential to increase the net annual income of South Asia’s poorest rural households by one billion dollars” (Shah et al. 2000).

In addition to its direct production and productivity effects, water resources development efforts, particularly the provision of adequate domestic water, will also have indirect productivity and production effects, and hence food security impacts through its effects on health and sanitation. This fact can be observed from Figure 7. Countries with higher total annual water diversion for domestic use per person had lower levels of the food deficit of the undernourished.

Figure 7. Relationship between Domestic Water Supply and Depth of Undernourishment



Policies and Actions

There seems to be a general consensus that the issue of food security is complex due to the interconnections among several factors. The most immediate ones are: lack of access to means of production (e.g., land and water) or insufficient purchasing power by households, unavailability of food, inappropriate distribution, and inadequate use of food at the household level. These causes are deep-rooted into a set of other causes including: socioeconomic and political environment (national policies and institutions) access to productive resources, natural calamities such as floods and droughts, and health and nutrition. Food security is not only an issue of security of having access to enough grains; it is also about balanced diets, nutrition, and health.

Mere availability of enough food at the global or national level will not guarantee that communities and households or individuals will be food secure. The problem needs to be addressed at various levels, national to individual level, considering various population groups (children, elderly, female, etc.).

Improved access to water by the poor, through effective management, helps enhance food security and livelihoods of the poor through enhanced production, consumption of both food and nonfood items, incomes, employment, and other indirect impacts. Lack of access, resulting mainly from ill-management, does the opposite and helps perpetuate poverty. Interventions are required to resolve problems of: “physical” water scarcity, “economic” water scarcity, and “institutional” water scarcity (e.g., poor management as well as inefficient, inequitable, and unsustainable use of water). Under the first situation, non-water related interventions will be needed to improve food security and livelihoods of the poor; the second situation calls for more pro-poor investments in the water sector; and the third situation calls for effective management of water through improved institutional arrangements.

In addition to broad interventions, finally, and most importantly, everybody should have the right to water and food, basic human needs. For improving the access of the poor to water to enhance food security, targeted interventions to increase benefits to the poor are urgently needed. These interventions are needed at all levels: the national, regional, community, and household levels. The following are some identified policies and actions that are needed to improve food security through improving water security of the poor:

- Increasing welfare/well-being per drop of water. Moving from more crop per drop or more jobs per drop to more welfare/well-being per drop of water
- Promoting equitable access to land, water, and food
- Promoting the IWRM or the river basin management approach. Sectoral approaches no longer generate desired outcomes
- Prioritize allocation of water to various sectors (domestic, agriculture, industry, and environment for sustainability)
- Using local wisdom/knowledge. Promoting technologies that are appropriate and indigenous
- Developing and improving legal and institutional frameworks or policies for ensuring the security of food and water for the poor
- Incorporating gender issues into policies and undertaking gender awareness training
- Enhancing the role of the private sector and markets in enhancing production and its equitable distribution
- Promoting support measures (e.g., education, awareness, capacity building, and the inclusion of women)
- Prioritizing geographic areas of focus (e.g., the poor or least developed areas)
- Promoting research on understanding linkages between water and poverty to identify pro-poor interventions
- Undertaking gender mapping in poverty studies and establishing gender audits
- Developing partnerships to undertake these actions

Conclusion

Based on the analysis and evidence, the study concludes that access to irrigation has significant impacts on food security and poverty reduction. Irrigation infrastructure can help ensure food security and lift both farm and nonfarm households out of permanent or chronic poverty by increasing productivity, employment, incomes, as well as expenditures, and indirectly, by enhancing related economic activities. Along with infrastructure development, availability of water is critical to the achievement of the stated benefits. Inadequate water supplies will reduce the impact of infrastructure on poverty, even if the infrastructure is well developed. Poor maintenance can lead to reduced water supplies and negate any positive impact on poverty reduction. Similarly, even if water supply is adequate and the infrastructure well maintained, the cultivation of low value crops or the absence of marketing facilities can reduce the impact of infrastructure on poverty.

Issues of smallholder agricultural development in general, and food security in particular, can no longer be divorced from issues of democracy, transparency, social justice, politics, and governance. Food insecurity is directly related to the secondary role accorded to agriculture in general and smallholder agriculture in particular. This secondary role is mainly so in terms of public sector support and investment in rural areas. The transformation of smallholder agriculture to a more science-based production system requires committed governance as well as a system of public and private sector organizations with the capacity and commitment to support and transform small-scale agriculture in terms of productivity and participation in the national economy. For food-insecure low-income populations, higher yields (per hectare and per drop of water) for food staples and therefore extra employment and self-employment income in growing them, will be the main source of enhanced food security. However, reducing poverty and food insecurity is not simply a question of enhancing agricultural productivity and production or of generating more income; it is fundamental to address institutional, political, and economic factors that tend to exclude individuals and population groups from progress. Unless policies, institutional arrangements, and public expenditure patterns which are counterproductive to integrated water resources management are realigned and improved, water that could be used successfully for improving agricultural productivity in irrigated and dryland agriculture alike, will be wasted and per capita food availability will continue to fall.

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