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FOOD SECURITY, DEVELOPMENT AND CLIMATE CHANGE

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Development can be seen as both a goal and a process. It has many meanings, often dependent on historical, ideological and theoretical interpretation. Here it will be defined as *the achievement for a very high proportion of the population of a country of a situation in which all basic needs are satisfied, with high life expectancy, gender equality and good level of security and safety, without deprivation of any other group of people or unsustainable use of the environment.*

Food security is concerned with the availability of adequate quantities of staples for a country. It is therefore a crucial component of basic needs, and inherent to development. Food production is a relatively narrow component of agriculture globally, and needs to be understood in the context of that wider sector. Agriculture is the economic sector whose production conditions are most affected by climate change (CC), and the impact on output of food staples is likely to be very significant, with wide regional differences in both increased potential and decreased output. Many of the countries that currently find it difficult to ensure food security are also likely to be negatively affected by climate change. Many of these are also countries which are least able to adapt to CC. By contrast, a significant number of countries which already produce surpluses are likely to experience altered climatic conditions that give them the potential for even greater outputs (Fig.1).

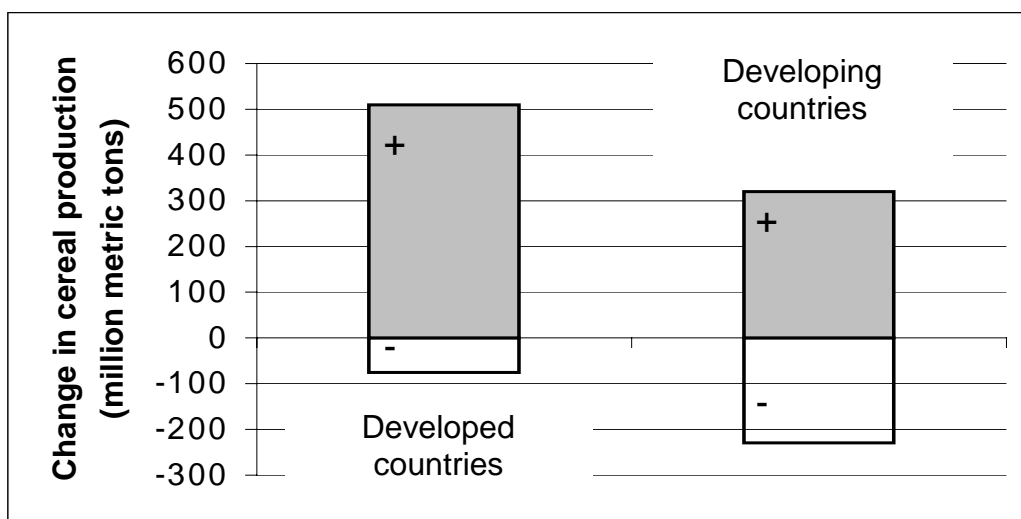


Figure 1: Impact of climate change on cereal production in developed and developing countries, comparing 2080 to 2000. Source: Downing 2002 (adapted from original in Fischer et al. 2001, p.23). TC adds: Note that the increase in cereal production is *potential*, while decrease is likely to be *actual*.

Of course there is no necessary relationship between potential for increased output and any inherent likelihood that such potential will actually be realised. In the global economy, agricultural production is already determined by factors that have little to do with ensuring global or national food security. There is no structured hierarchy of priorities that ensures that basic needs are fulfilled in advance of other uses to which agricultural resources are applied. That there are currently surpluses of staples for international trade (and aid) is a result less of economic rationality in a free market and more a reflection of politics in a few surplus producing developed countries. And we also have the situation where a few countries (including India) which are not yet 'developed', with significant proportions of undernourished people that have been able to export food staples in recent years. There are also some developing countries which have exported food staples to EU countries for use as animal feed. There is nothing inherently 'wrong' with such trade if it is certain that other means of ensuring food security are in place. But they are indicative of a global structuring of trade in agricultural products that is not capable of dealing with need, and are based instead on power and wealth. Given this type of structuring of international patterns of agriculture, there may be additional changes that run parallel with CC adaptation if food security is to be ensured.

Food security at country scale

Food security is normally measured in terms of the balance between estimated need for staple foods and availability at the national level. As such it is a simple expression of the staple food output of a country, minus assumed consumption needs, plus net foreign trade and aid flows. Achieving food security is seen in terms of an adequate net combination of output and imports, with aid flows providing the variable that balances net availability with need. In the past, more emphasis was placed on food security being largely met from domestic output. In recent years (under the influence of neo-liberalism) some have argued that there is no reason why a country should not rely predominantly on imports should that offer a cheaper and more 'efficient' way of providing for the people. (This of course requires that there are other surplus-producing countries able to trade.)

| Change Share under-nourished | Number of countries in group | GDP 1995 \$ per capita | % of population under-nourished | Present cereal production, mmt | Cereal gap, mmt | Climate impact on cereals, mmt |
|------------------------------|------------------------------|------------------------|---------------------------------|--------------------------------|-----------------|--------------------------------|
| Losers | | | | | | |
| - Low | 11 | 2113 | 9 | 129 | 1 | -12 |
| - Medium | 19 | 486 | 23 | 307 | 9 | -19 |
| - High | 10 | 264 | 48 | 39 | 5 | -2 |
| Gainers | | | | | | |
| - Low | 17 | 1658 | 11 | 513 | 5 | 111 |
| - Medium | 8 | 198 | 24 | 29 | 1 | 11 |
| - High | 13 | 184 | 53 | 26 | 4 | 6 |

Table 1: Climate change impacts on cereal production potential in 2080 related to present prevalence of undernourishment. (Source: Downing 2002, adapted from Fischer 2001, p.28). mmt = millions of metric tonnes.

Whatever way the concept of food security is used, it is clear that for various reasons it is not being achieved, even when there is supposedly a global surplus of staple foods. Table 1 shows the current production of cereals in 78 developing countries (which account for 99 per cent of FAO-defined undernourished population of the world). These are grouped according to whether they will lose or gain in cereal production potential, and then their current percentages of undernourished people (indicated as low, medium and high in the left hand column). It is evident that there are significant current 'cereal gaps' in all of these countries, and that international trade and aid is not solving it. While some of the developing country CC gainers have potential for enormous increases in their outputs, we need to be very clear on the conditions under which this potential will be translated into actual production, and how this potential surplus might actually be traded or used as aid to the deficit countries which will lose real production.

Many governments (especially in countries with large proportions of rural population) are reluctant to accept significant reliance on trade to achieve food security. This is partly for reasons of having more confidence in self-sufficiency, national pride, fear of being vulnerable to decline in traded surpluses, price rises and political manipulation. (In recent years international trade in agricultural products have been subject of a 'green' argument, in terms of the environmental costs of the 'transport mile' calculation of food movements. Given that CC is likely to increase the need for surplus countries to transport large quantities of staples around the world, the costs argument may be extended).

The trade and aid components of the traditional view of food security have interesting connotations for climate change. With the expected shifts in the production conditions of many countries, some poor countries face reduction in their ability to achieve food needs from domestic production, and therefore potentially greater reliance on imports. Some countries would be able to produce even larger surpluses under CC, which would more than 'cancel out' the deficits. But it is impossible to be certain that they would do this – the climatic ability to produce may not be translated into actual increased output – or to know what world prices of staples will be under such conditions.

Many food deficit countries also rely on agricultural outputs as their main export earners. Although there may be some scope for substitutions, current crops are also likely to suffer reduced output under climate change. So food deficit countries will then be less able to import food. The implications of this in relation to world price of staples is of significance too. The ability to purchase food by poor people may not improve (especially in less developed and CEECIS countries) if they are earning less from non-food farm outputs.

The traditional approach to food security is understandable from the perspective of governments and international agencies. It is a corollary of the system of national sovereignty that governments assume some responsibility for achieving food security, and for international agencies to see part of their role as supporting this goal. The goal of food security defined in this way does not require any major challenge to issues of power, inequality and poverty – the factors that are largely responsible for determining access to food and the characteristics of agricultural production. It is a seemingly logical approach to the avoidance of hunger and famine,

and involves visible and quantifiable amounts of physical goods and transfers – tangible things which give the appearance of having significance.

It is also compatible with neo-liberal approaches which de-link national food production from national food needs, and argue for free trade in staples to maximise production and resource efficiency. However, this relies on there being a global tradable surplus (and with staples that are acceptable to the tastes of the importing country, and at prices suited to local incomes), and a global buffer stock for aid transfers that is readily transportable on a timely basis.

These last two conditions are currently dependent on the agriculture system operating in a few surplus producing nations some of which operate sizeable farming subsidies. Their exports and aid donations are in part politically motivated (both to support producers and influence recipients). Here we will assume these conditions remain in place, although we should perhaps take into account current views on their likely continuation or direction of change. These assumptions are made the more interesting if we build in the likely impact of climate change (CC) on production conditions in existing surplus producing countries (which are likely to experience changes in climate that could produce an increase in output of current and new crops).

Staple food production for nutrition is only a sub-set of agriculture, which produces many crops only some of which are necessary for nutrition or other essential needs, and some of which play no part (or only a marginal part) in nutrition at all. Agriculture can be defined as having five sub-sectors:

1. Staples (mainly grains, root and tuber crops)
2. Non-staple nutritional foods (mainly oilseeds, soya, pulses, meat, fruit, vegetables)
3. Staples not consumed directly (used in animal feed, brewing and distilling)
4. Industrial crops and other raw materials and consumer goods (fibres, construction materials, paper, rubber, flowers, tobacco and other drugs)
5. Non-nutritional foodstuffs (especially beverages, sugar)

To understand food security, it is essential to analyse it in the wider context of the entire agricultural system including all these sub-sectors. In particular, we need to understand the factors that determine the balance of production between the five sub-sectors, and what is likely to happen to these under CC. This wider agricultural economy is global, and the balance between the five sub-sectors is largely driven by purchasing power (and therefore by income distribution) which when high increases demand for agriculture to concentrate more resources on:

- a. peoples' needs for products other than food (including fibres, construction materials, paper, rubber, other 'industrial crops' etc.); and
- b. peoples' wants and preferences, including food crops that are not essential for nutrition (beverages, beers and spirits, tobacco and other drugs, sugar, cacao, flowers, animal proteins, etc.).

'Effective demand' for these agricultural outputs is highly skewed as a result of enormous differences in income and wealth within and between countries (with the

richest 20% of the world's population commanding around 80% of the income). Output of non-staple and non-food crops is determined mainly by extremely unequal income and wealth distribution: what is grown on the land is a function of that inequality. The allocation of productive resources between sub-sectors 1, 2 and 3 is (in developed and developing countries, and increasingly CEECIS) a product of processes that are not based on nutritional need, but on variations in wealth.

The income and wealth factor affects the disposition of resources used in production for food as well as non-staple and non-food agriculture around much of the globe. There are several reasons that this is significant in regard to CC and food security. First, it must be noted that CC may be a relatively remote factor influencing the ability of many poor people to fulfil their nutritional needs. We need to know if existing factors that determine global agricultural patterns (and which affect the capacity of the majority of people who live from the land to feed themselves) are likely to remain more significant than CC in determining food security. We need to have some understanding of whether CC will maintain, worsen or improve peoples' ability to feed themselves in this wider context. Secondly, in less developed countries the income of the rural population from the production of non-staples and non-foods must be sufficient to substitute for self-provisioning (this is the neo-liberal argument that subsistence is not necessary under conditions of wage-earning and free trade). We therefore need to know the extent to which CC may influence the balance between output in the five agricultural sub-sectors in particular country contexts. This is extremely difficult if not impossible to predict.

From food security to entitlement security: a food systems approach

An alternative approach to food security begins with a different set of questions and factors. It is also potentially more useful in relation to CC. Rather than asking whether a country can achieve a balance between net output and need (with or without imports or aid), it sets out to understand the factors that affect conditions of production, sales, foreign and domestic trade, delivery and transport, and household consumption. While the objective is to understand access to food, it takes into account the wider agricultural system and the fact that producers are making choices between crops in the five sub-sectors as above in relation to factors other than nutritional needs. This approach could be called Entitlement Security (as an echo of Sen's work on hunger and famine), rather than Food Security.

Using this alternative approach, we can ask why certain groups of people are predisposed (vulnerable) to hunger on the basis of their inability to consume enough food (rather than inadequate national availability as measured in the food security approach). This permits taking account of various issues (e.g. prices) which may prevent adequate consumption even when there is food available. The policy implications of understanding vulnerability to hunger as inadequate consumption (entitlement insecurity) rather than inadequate availability (food insecurity) are likely to be different. Policies directed at food security (balancing production with estimated need) may increase availability, but do little to improve entitlements.

Food systems

The satisfaction of nutritional needs is the main 'basic need' of all people. It involves a spectrum of ways for people to access food, at one end of which are those people who purchase all their food, and at the other (still the majority of the world's

population) those who grow crops or raise animals largely for own consumption. These could be termed income-based and asset-based food entitlements. Of course using income or assets to access food does not mean that people necessarily obtain all they need. We can consider all of the combinations - from buying all to growing all food – to be part of ‘food systems’. Food systems can then be defined as the combination of social (including economic and political), and natural components that lead to the potential satisfaction of nutrition for a given individual or household. A food system includes four sub-systems: Production, Exchange, Distribution, and Consumption (P,E,D, and C), with a progression from P through E and D to the final satisfaction (or not) of nutritional needs at C. Each of these is discussed here, with some indications of how *negative* impacts of CC are likely to affect the sub-systems.

Production involves the *assets available* to a person or household that enable them to engage in agriculture. These include especially access to land, water, pumps and related fuels, tools, perhaps traction (some from animals), livestock, and possibly inputs such as fertilizer, compost, pesticides, credit and labour. Part of production may be food for self-provisioning, or farm crops (often including foodstuffs) for sale (which can then be realised as food through purchase). A crucial element of the asset portfolio is the ownership and control over these production assets: who owns or controls them, are rents applicable and if so how much? **Under conditions of climate change, production is affected in very direct ways** which have been well analysed in the CC literature (the connections are relatively straightforward and ‘knowable’). There are also likely to be **indirect negative impacts** arising from the coping mechanisms that some poor people adopt to deal with their hunger. These may have potentially damaging impacts on the environment, and generate secondary negative CC results. These issues are discussed later under a separate heading, since they are likely to be significant for a large number of people in deficit countries. The more direct impacts of CC on Production include:

- Changes to rainfall and temperature regimes, with resultant shifts in cropping potential, growing season, pest and disease incidence;
- Increased variability of climatic conditions and alterations to peoples capacity to manage traditional production systems;
- Increased frequency, intensity and duration of extreme weather conditions, especially drought, flood, tropical cyclone, storm surge, wind and storm, all with potential to damage land and standing crops, peoples houses, livelihoods, income earning opportunities;
- Increased incidence of vector and water-borne diseases, with consequent impacts on working capacity of farm labour, increased poverty.

Exchange consists of the transfers and transactions between agricultural producers, intermediaries and consumers (of all types – including urban dwellers who produce no food). It includes transactions in cash or in kind, and does not necessarily mean only market relations. In the sense intended here, exchange means the transfers of physical products and the associated streams of income, rent, interest. These exchange relationships are influenced by a range of processes and agencies. These will vary also to the extent that the economy is monetised or commodified. The type and reach of State activity is a significant factor, in determining the behaviour of the various actors involved (for instance the credit system, market regulation, state commodity boards, foreign exchange rates, taxation and revenue). This component of the food system also involves foreign trade: in this way, imports and exports (of

food and other agricultural outputs) are analysed in relation to the political economy and not to an assumed neutral balancing of needs and output in the normal food security model.

It is the **Exchange component which is mostly indirectly affected by climate change**, and which is deserving of much greater attention. These indirect impacts must include all five sub-sectors of agriculture, not just staple foods. The key issue here is that for deficit countries the reduction in capacity to grow current crops will really decline, while the projections for surplus countries to increase output are only potential: it is in the arena of Exchange relationships that the potential for increased output will or will not be realised as actual output. The associated issues derived from CC here include:

- the changed *potential* for production in different regions and countries,
- changed variability in output in different countries and regions,
- likely impacts of changes on prices and therefore *actual* output levels in deficit and surplus countries;
- resultant shifts in the balance of output in the five sub-sectors;
- role and response of national governments in surplus/deficit countries
- international action in regard to surplus/deficit countries, and whether new instruments of international co-operation can be developed to reduce inequality and ensure that deficits are matched by actual increased output in high potential areas.

Distribution involves the physical transfer of food from producer or intermediaries to consumers. This component of the food system involves the systems of transport, storage, management of inventories and the necessary communications involved in making the system work. As in the intermediary processes of exchange (above), there are also losses through damage and pests which need to be considered, and which act to reduce the amount of food available for final consumption. If CC leads to increased international transport of staples, then distribution will be affected by rising transport costs. Distribution is susceptible to political and strategic matters, as food is often withheld in times of war as a means of forcing military objectives. Food may also be sequestered for use by the military and normal patterns of distribution interrupted.

The **impacts of climate change on Distribution will be both direct and indirect**. The negative ones may include:

- disruption to transport and damage to networks by increased frequency or intensity of hazards (especially rainfall and flooding);
- increased incidence of pests and diseases of crops in store and transport, and the possible spread of pests and diseases to new areas;
- damage to storage facilities by increased rainfall, flooding, wind damage from storms and cyclones;
- lack of capacity to store unpredictable or infrequent surpluses that arise in some areas;
- increased disruption of supplies by military or civilian action in areas where reduced output leads to increased insecurity and conflict;
- impact of transport costs on increased international trade and prices;

Consumption is the component of the food system at which peoples nutritional needs are met at individual or household level. Consumption entitlements will vary

considerably in relation to urban or rural context. It is also subject to gender variations, especially the feeding priorities of males over females in many parts of the world. Key issues in consumption include the balance between need and availability of food staples and other foodstuffs, the source of food (between self-provisioning and purchase), the strategies for dealing with deficits (coping mechanisms), and the potential for food aid in such deficits.

The negative **impacts of climate change on the Consumption component are likely to be both direct and indirect**. They include:

- shifts in consumption from better to less nutritious cheaper foods;
- worsening of the household consumption hierarchy which may disadvantage females and children.

In effect, a food system consists of four components, the final one being the point at which people seek to satisfy their nutritional needs through consumption. There are significant intermediary processes between production and consumption which affect people's entitlements to adequate nutrition, as well as powerful determinants of the ability to produce adequate food in the production stage. The food system could be considered as a series of entitlements that progress from production, through exchange and distribution to final consumption. At each stage (in each component) there are crucial political and economic factors that affect what a person is ultimately able to consume. The task is to animate the political economy of these factors in relation to CC.

If a person or group has a deficiency in the manner in which one or more of these components affects them (for instance, inadequate land, or credit at high rates of interest), they are likely to suffer hunger or malnutrition. Disruption of peoples' access to food in one or more of the components P, E, D or C may also cause hunger (for instance changes in marketing systems, prices, availability of land, credit, terms of trade). Food systems are a sub-set of agriculture, and both are subordinated to the political economy at the regional, national and global levels. So deficiencies or disruptions in the food system may be caused by factors or processes which are apparently quite remote in space or time from the immediate site of consumption and hunger. The combinations (including subsistence farming/ wage earning/ bartering/ trading) in which many rural people in less developed countries engage to satisfy their nutritional needs are integrated with much wider systems which influence their food systems and strategies for the use of available resources.

Using the food system's four components, we can distinguish between different causes of hunger (which may have varying policy implications), and in regard to CC identify the points at which changes to each of these may be influenced by climate factors. This is a much more 'people-centred' means by which entitlement insecurity can be addressed. It allows for a range of policy interventions that are more attuned to the potentially wide-ranging deficiencies and disruptions of food entitlements rather than the crude national balance approach of the food security model.

Food systems, climate change and environmental consequences of coping¹

The food system model can be extended to analyse certain types of environmental problems and how people in both high potential and deficit countries are likely to

respond in using natural resources under conditions of CC. In particular the food systems approach allows us to examine how vulnerable people deal with disruptions of food systems by various coping strategies, sometimes with damaging impacts on the environment. People whose access to food is disrupted (e.g. by drought, war, or other natural or social factor) may resort to coping strategies which lead to environmental degradation. This demonstrates that one of the necessary conditions for sustainable development (enabling future generations to fulfil their needs in utilizing the same environmental resources) is the reduction of present levels of vulnerability to CC and 'normal' disruptions of food entitlements.

The focus here is on environmental problems as they relate to the way the environment is used (as a set of production resources) by 'poor' people. In particular, it is concerned with coping strategies, and so other anthropogenic processes of environmental degradation that are caused by other groups of people are not considered here.

Coping mechanisms are normally intended by the people who resort to them to be short-term. Of those designed to avoid hunger, some may not lead to damage of the environment (e.g. eating different kinds of foods caught or gathered from the wild). But others involve measures which severely deplete those environmental resources which are crucial to the livelihood of the affected peoples. A reasonable and rational survival mechanism for the private preservation of the individual becomes a seemingly irrational and self-destructive form of behaviour affecting the future of the wider community. Such coping is designed to preserve livelihood assets (e.g. livestock) and may not be directed to the immediate hunger issue.

In circumstances where coping mechanisms become long-term, they can lead to severe damage which may be virtually irreversible, as with soil erosion. In these situations, such practices are no longer really coping mechanisms used to survive an expected or actual dearth of food, nor are they temporary emergency measures for the preservation of livelihood. Instead they become the normal method of existence: people are forced to destroy their own and their descendants' future in order to survive.

Detrimental shifts in production and exchange entitlements may lead people to compensate by more damaging use of the environment. Sustainable development (as an environmentally non-damaging set of policies) or sustainable livelihoods can be achieved only by improving livelihoods and removing peoples' need to seek individual solutions through coping mechanisms which are harmful to the needs of the broader group and future generations.

Food systems and climate hazards

Environmental hazards (such as drought or flood) act on Production and Exchange to reduce the resource base of those who rely on land and water as part of their productive assets, and indirectly for those who rely on the purchase of food at prices which give adequate nutrition on their normal wages or through other exchange entitlements. So environmental changes can also lead to increased vulnerability for some by generating shifts in their entitlements. In this sense, the environment must be seen as integral to food systems, and not as something external and outside

them. It consists of a range of production resources, access to which is determined by the economic and political system (Blaikie et al, 1994).

Production can be affected by natural hazards, because nature itself provides some of the means of production for agriculture - especially land (soil), water and climatic conditions. But the issue is not whether production is lower because of the impact of an environmental hazard (such as drought or flood), but how lower output - through whatever cause - is linked to reduced consumption. The crucial issue is not so much reductions in output as shifts in the means by which people - through their entitlements - are able to secure their consumption needs. People are already, prior to the 'trigger event' of a drought or flood, more or less predisposed to its impact by their level of vulnerability. This vulnerability is derived from the processes of the political economy, which distributes risk differentially among various groups of people. In other words, the extent to which CC – induced hazards will affect people is a factor of their food system entitlements, rather than the impact of nature itself. Policy for dealing with natural hazards under conditions of CC are then not likely to be substantially different from current needs. They amount to the importance of reducing peoples' vulnerability by improving their baseline status (health and nutrition), their capacity (through a robust livelihood) to protect themselves from hazards, the availability of suitable social protection measures (e.g. FEWS in relation to drought, cyclone warnings and shelters, flood proofing, insurance and food distribution), and a livelihood that is resilient to the disruption of the hazard.

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¹ This section relies on Cannon (1991) for some of its content.