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The Household Economy Approach. Managing the impact of climate change on poverty and food security in developing countries

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ABSTRACT

Climate change is expected to have severe effects on the populations of developing countries because many of these depend heavily on agriculture for income, have large impoverished rural populations which rely on agriculture for subsistence, and are financially and technically least equipped to adapt to changing conditions. Planning to target measures to support adaptation to reduce the impact of climate change on poverty and food insecurity requires methods of identifying vulnerable households. This paper describes an established approach to vulnerability assessment, the 'Household Economy Approach' (HEA) and its potential application to the management of climate change in developing countries. The HEA is widely used by Governments and others, chiefly in Africa, for the assessment of household vulnerability to poverty and food security. HEA uses a model based on Amartya Sen's entitlement theory and detailed social and economic data to simulate the impact of weather related, price, policy and other shocks on household income and food access, to provide information for decision making. In developing countries climate change will be experienced in terms of increased climate variability and an increased frequency of extreme events. HEA provides a way of managing the effects of year to year shocks to prevent impoverishment and the erosion of household resilience. It also provides the information needed to develop scenarios to support the design of policies to support longer term adaptation. HEA data has already been collected for large areas of Africa.

Introduction

The Intergovernmental Panel on Climate Change (IPCC) expects that in developing countries climate change will have major impacts in the near-term and beyond on water availability and supply, will lead to shifts in the production areas of food and non-food crops and will have major impacts on food security and agricultural incomes, with a disproportionate

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impact on the welfare of the rural poor (IPCC, 2014a). Planning to target adaptation to reduce the impact of climate change on poverty and food insecurity requires methods of identifying vulnerable households.

Assessing household vulnerability (e.g. the 'magnitude of the threat of future poverty' (Calvo and Dercon, 2005)) to climate change presents the difficult problem of understanding the interaction between multiple climate impacts (e.g. on water, heath, agriculture, prices) and non climate changes (e.g. political, institutional, demographic, economic, social and technological) occurring at different scales on complex location specific social economic systems.

Amartya Sen's entitlement theory (Sen, 1981) and a successor, the DfID sustainable livelihoods approach (Scoones, 1998) have been widely used as a conceptual framework for understanding the relationships between shocks and other contextual changes and livelihoods (Adger and Kelly, 1999; Bohle et al., 1994; Ribot, 1996; Turner et al., 2003a). Entitlement theory explains a person's (or household's) ability to get income, food and other necessities in terms of their ability to exploit their 'endowment' (essentially land, livestock, labour and other productive capital) within the prevailing conditions of production, prices and the framework of legal, social and customary rights. This concept is expanded by the sustainable livelihoods approach to include a wider range of 'capitals' (human, social, natural, physical and financial).

A central difficulty in translating this concept into a practical method of assessment is that vulnerability is household and context specific. Adger (2006) has argued that a practical system of vulnerability assessment requires a generalised measure which can capture relative vulnerability and its severity across a distribution and which is also sensitive to the redistribution of risk within a population. For example a household will be directly affected by food crop failure only to the extent that it depends on food crops for income. The severity of the impact will depend on the size of the household's income and the outcome in terms of its income and food access on its ability to compensate for any loss, e.g., by realising the value of livestock and other assets, finding alternative employment, redistribution (e.g. from kin), which in turn will depend on the particular social, market and institutional conditions at that time. Particularly in the rural areas of developing countries livelihoods vary between locations and within populations (e.g. between rich and poor); they are characterised by multiple income sources (from agriculture, employment, wild foods and hunting, transfers); in more extreme environments are often highly adapted to cope with risks, and continuously change and adapt to changing environmental, market and other constraints and opportunities (Morton, 2007).

Approaches based on livelihood frameworks have been developed for research and operational use (Fraser et al., 2011; Løvendal et al., 2004; Reed et al., 2013; Turner et al., 2003b). These provide a logical approach to understanding livelihoods and how these are likely to be affected by shocks and changes, the constraints on people's ability to cope and adapt and suggest steps which might be taken to reduce vulnerability but have the limitation that these are based on informal data collection techniques, are qualitative and can be used only at relatively local scale. The IPCC notes a lack of studies which assess the distribution of poverty at the level of households, critical thresholds and poverty traps, in the context of climatic and non climatic stressors (IPCC, 2014b).

At a large geographical scale there are conceptual and data constraints with the development of practical assessment methods. In many developing countries household surveys are conducted primarily for national accounting purposes and poverty monitoring and there is a paucity of recent detailed large scale household level data. Econometric techniques raise conceptual issues (e.g. see Moss et al., 2001; Skjeflo, 2013 and are limited by the available data (Skjeflo, 2013; Hoddinott and Quisumbing, 2003). Indicator systems have been widely used although there are difficulties with the selection of suitable indicators (Füssel, 2009). Efforts have been made to systematise indicator selection to better reflect the underlying dynamics (Adger et al., 2004; Eriksen and Kelly, 2006). The IPCC has developed scenarios to 2100 based on a range of climate scenarios and assumptions about adaptive capacity (IPCC, 2000).

This paper describes an established operational approach to vulnerability assessment (the 'Household Economy Approach', HEA), which is widely used by Governments chiefly in Africa for the year to year assessment of household vulnerability to poverty and food insecurity and discusses its current and potential application to the assessment and management of the impact of climate change. The approach uses a model based on entitlement theory and detailed social and economic data to simulate the impact of production price and other shocks on household income and food access. This addresses some of the difficulties in vulnerability analysis identified in the literature. Data has been collected for large areas of Africa.

Background

HEA was originally developed to meet the need, first recognised internationally by the 1974 World Food Conference for a reliable method of 'famine prediction'. Specifically it arose from observations in the 1970s that famine had paradoxical features, notably an inconsistent relationship between crop failure, price changes and other shocks, and hunger (e.g. Seaman et al., 1973). This as is now well known is due to household resilience. Vulnerability is reduced by income diversification (Ellis, 2001) and to a variable extent in different locations households can compensate for a short term falls in income by consuming food reserves and wild foods, realising the value of livestock and other assets, finding alternative employment, migration and sharing resources (Corbett, 1988). It was also evident that particularly for the poor 'coping' carried a cost, in terms of forgoing health, education and other services, a period of hunger, long distance migration, engaging in prostitution, or other hazardous occupations, or the sale of assets leading to impoverishment, the erosion of household resilience and increasing future vulnerability.

From an operational perspective these observations redefined the problem of 'famine prediction' in terms of the need for a method which could reliably predict the impact of a shocks and changes on household food access irrespective of the severity of the impact. Action is required to prevent starvation but governments may also wish to act to prevent lesser impacts which impede development efforts, e.g., reduced use of education and other services, asset sales leading to long term impoverishment and risk-averse patterns of livelihood (Dercon, 2004).

In 1981 Amartya Sen's entitlement theory explained the long standing difficulty of defining famine (i.e. it is a special extreme case of poverty which occurs when many people are unable to meet their food entitlement) and, as noted in the introduction, provided a general framework which explained the field observations. The corollary was that prediction required a model which could combine location specific information on livelihoods, assets and other 'coping' opportunities with information on shocks and changes.

Preliminary work in the run up to the 1984 Ethiopian famine showed that this might be a practical undertaking, and from 1991, initially in collaboration with the UN Food and Agriculture Organisation Global Information and Early Warning System, a systematic effort was made at the Save the Children Fund (UK) with European Union support to develop a practical operational approach. This was extensively tested in local assessments and since 2001, when it was successfully used to predict the 2001/2002 Malawi famine has come into wide use by governments, NGOs and others chiefly in Africa.

Model specification

An operationally useful model was specified as one which could predict the impacts of multiple stressors and contextual changes:

(i) Sufficiently early to allow intervention before households sold assets or took other adverse steps to survive.
(ii) Taking into account household needs for soap, clothes, health and education costs and other non-food goods. For many poor households 'food security' is an elastic concept. All households require some non-food goods and households which cannot afford to meet both their food and non-food needs must make trade-offs between the two.
(iii) In terms which were sufficient to plan a response (i.e. the severity, location and timing of an impact and a quantitative estimate of the alternative actions which would prevent crisis) and be sufficiently convincing to persuade governments and international donors to make the substantial resource commitments which are sometimes required.

A method was needed that could be used routinely at a national scale, under real operational constraints including data limitations and situations of conflict, at an acceptable cost. The more general objective of predicting less severe impacts justified the cost of developing and maintaining the large information systems required. Unambiguous famine is rare and in most cases results from exceptional circumstances (e.g. ungoverned war zones such as Somalia in 2012).

The Household Economy Approach

The HEA uses a model based on household data for a defined reference period (usually an agricultural year, e.g., main crop to main crop) in which conditions are known, i.e., a 'good' or 'bad' year to estimate the change in household's food access which would be expected from a shock or change in a current 'prediction' year, factoring in the amount of food and non-food goods which the household should be able to obtain and the types and acceptable use of 'coping' strategies, e.g., a household might survive by selling all its livestock, but in policy terms this might be considered undesirable.

The reference data set includes the distribution of household membership, asset holdings, income and income sources and information on potential 'coping' strategies including the value of asset holdings, employment opportunities, access to wild foods and transfers.

Shocks and changes are expressed as changes to the price and/or production of any produced or traded item in the reference data.

A simple model is deliberately used to ensure that the user has an intuitive understanding of the calculations. Simulations are used to develop a narrative about the connection between a shock or other change in which the uncertainties about the values used, e.g., future food and crop prices, are explicitly declared and which is comprehensible to non-technical users and open to challenge.

HEA is described as an approach rather than a method because it is a framework which defines the minimum information required and a way of analysing this. The quality of the data required depends on the objective of the assessment and the acceptable quality of output.

Two quantitative reference data sets are in use:

1. A simplified data set which was designed to allow data to be collected and maintained at reasonable cost at national scale, although this can be used at any scale. A one off investment is required to collect the reference data which can be updated at lower cost. The method of data collection restricts the use of the data collection technique to rural areas.
2. A more conventional data set collected from individual households. This extends the use to urban areas and to development and research applications and is described further in Supplementary note 1.2.

The simplified large area data set

Countries are divided into livelihood zones (LZs), defined as areas in which households obtain their income by largely the same combination of means, both in good and bad years. As patterns of income vary within livelihood zones the size of a zone depends on the use to which the data is to be put. In national use where the model is used to make preliminary estimates which will be followed up on the ground, larger livelihood zones are used to reduce the cost of data collection. Within each LZ data is collected at purposive sample locations (typically 8–10) selected to maximise the variation between sites. Standardised 'participative' techniques are used to collect information from key informants (i) at community (typically a village) level; (ii) in groups representing each wealth group recognised at that location. The result (Fig. 1) is an approximation of the income distribution, income sources, patterns of expenditure, assets and other reserves and access to alternative income sources for a locally defined asset based wealth distribution.

Information is also collected on the experience of past hazards and the way in which people responded to these and a great deal of social, market and other incidental information is also obtained.

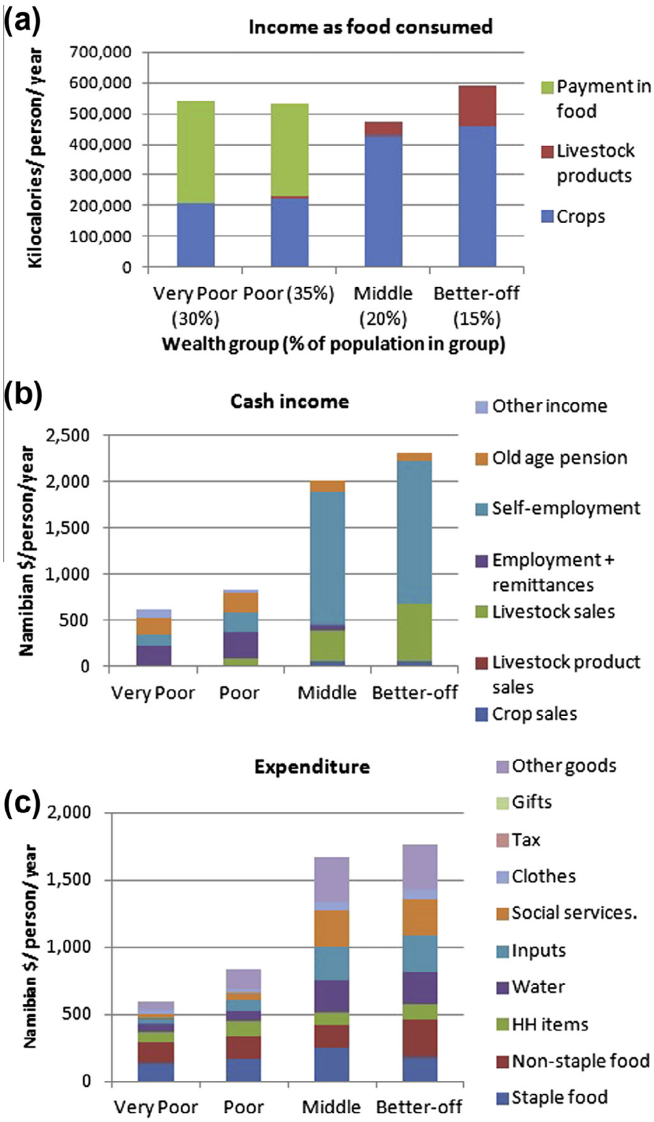

Fig. 1. HEA income and expenditure data by wealth group for the Northern Border Upland Cereal and Livestock Zone, Namibia for the reference year March 2006–February 2007. (a) Income as food energy consumed and the proportion of the population in each wealth group. (b) Income in cash. (c) Expenditure. Crops include millet, sorghum, maize, beans and bambara nuts; livestock are cattle, goats and chickens; employment is mainly in agriculture (weeding, harvesting, fencing some of which is paid in food). Self employment includes construction, firewood and basket sales. Wild foods are mainly Marula fruit. A government old age pension is provided. Source: Government of Nambia.

The data collection technique is summarised in Supplementary note 1.1 and a detailed manual is available (Holzmann et al., 2008). Income data is notoriously difficult to collect (Azzarri et al., 2010) and the technique used is described in Supplementary note 2.

Values for each wealth group are assumed to approximate a midpoint for that group. The use of locally defined wealth categories means that the income distributions of different LZs cannot be directly compared.

The simplified data set includes data on all the important income sources in a zone, i.e., it omits some wild foods and other very minor sources of income. The individual household data (Supplementary note 1.2) provides very detailed information, e.g., in one study 50 types of crop (including green and unprocessed crops), 89 types of employment (including several types of agricultural labour) and 40 types of wild foods (wild fruits, leaves, fungi, insects and birds and other animals) were recorded (Seaman et al., 2008).

The income classification

The key to the approach is a classification of income sources which is used both to structure income data collection and for the simulation model. Income sources are divided into: (i) income obtained by the household in the form of food which is directly consumed by the household (from production, employment paid in food, wild foods and hunting and transfers), e.g., between kin or in the form of food aid and other external assistance, and is not traded or otherwise used, e.g., retained for seed. (ii) income in cash (from production and wild food sales, employment paid in cash, cash transfers and the sale of transfers in kind).

The model

Using the simplified data set, for a single wealth group the model (units in kilocalories (kcal) and local currency) is:

Household food access in a prediction year (kcal) = Household food requirement (kcal) – ($\sum$ $i = 1 \rightarrow n$ food sources (reference value income as food consumed (kcal) (i) + (reference value income as food consumed (kcal) (i) * % change in production of food consumed (kcal) (i))/100)) + ($\sum$ $j = 1 \rightarrow n$ cash income sources ((reference value item sold (j) + (reference value item sold (j) – % change in production of item sold (j))/100) * actual or expected sale price (j))/actual or expected sale food price per kcal) + additional food income + (additional money income/food price per kcal) – non-food costs.

1. *Household food energy requirement.* In large scale analysis only access to food energy is considered, not other nutrients. The value used is usually 2100 kcal person/day (the average requirement per person for a population with a population pyramid 'typical of a developing country' (World Health Organisation, 1985) although this may be increased or decreased under some conditions, e.g., very cold locations, remote locations where there are difficulties supplying food aid. In many places 2100 kcal/person/day exceeds the food energy available to the poorest households even in a 'good' year and the use of this value overestimates the deficit. In practice this can be ignored as it allows a margin to allow for the inaccurate targeting of food aid or other welfare assistance.
2. *Income sources as food and cash.* The reference values for each income source.
3. *The change in food and cash income.* This is the change in the actual or expected production and/or price of any item produced or traded in the LZ. Reliable quantitative production values are rarely available at the geographic scale required. Crop and other production changes are expressed as the percentage of the change or expected change from the reference year, a form in which information is relatively easily obtained from field work. Prices are in local currency at current or expected values, e.g., for cash crops.
4. *Non-food costs.* These are based on the cost of a user defined basket of goods (e.g. soap, clothes, health costs etc). A lower 'survival' level of non-food consumption is often used as in many places poorer households cannot afford an acceptable level of non-food consumption even in non-crisis years.
5. *Additional food and money income.* This is the potential income which a defined wealth group could obtain from the sale of livestock and other assets, additional or alternative employment, increased wild food consumption, transfers, etc., within limits set by the user. For example, households might survive by selling a large proportion of their livestock holdings but this might be considered to be an undesirable policy. Estimates are derived from the reference values, expert local judgment (e.g. the value to be used for transfers between households) and are often refined by additional field observations.
6. *The current/expected food price.* The value used is usually the expected midyear price of the staple food consumed by the poor. The price of more complex diets may be used. Food and other price projections are based on a historical understanding of the market and current market intelligence.

Model output

The output of a simulation is an estimate of the food access of each wealth group relative to the reference values. Estimates can also be obtained: (i) of the gross food deficit, with population data for the Livelihood Zone, (ii) as the money equivalent of a food deficit (e.g. to estimate the amount of money or the value of a voucher which would have to be distributed to deficit households to allow them to purchase sufficient food at a set price). With additional data on the month(s) in which income is obtained, e.g., the dates of harvests, periods of employment. The model can be extended to estimate the time at which an impact will occur although this is usually estimated.

The large area model is expressed using spreadsheets and other software (Supplementary note 3).

Defining shocks and contextual changes

The model allows any local, national or international event which can be plausibly expressed in terms of price and/or production for any livelihood zone and wealth group to be incorporated into a simulation in any combination, irrespective of its location or primary cause.

These include (i) weather related production hazards, e.g., floods, drought; crop and animal disease. (ii) Price changes or expected changes arising for local or exogenous reasons. For example, the sharp increase in maize prices in Malawi in 2001 which led to famine, the increase in the international rice price in 2007, the collapse of livestock prices across East Africa following the Middle East import embargo imposed because of Rift Valley Fever (Holleman, 2002). (iii) Political and policy decisions, e.g., the collapse in remittances to Darfur from migrant labour in Libya following the UN embargo in the 1990s; the currency revaluation in Malawi in 2012 which caused a fall in farm cotton prices and a rise in the price of food and non food goods prices (Govt. of Malawi, 2012).

The model can also be used to simulate the impact of alternative interventions, e.g., the provision of cash or food, price stabilisation, fertiliser, reducing fees and taxes, changes in transaction costs.

Reference data coverage

Fig. 2 shows the livelihood zones with data for the Sothern African region. There is complete data coverage of Ethiopia (FEWSNET, 2009), some coverage of other parts of east Africa and some coverage of much of Sahelian West Africa (HEASahel, 2014). USAID/FEWSNET (Famine Early Warning Network) have zoned many other countries and developed more limited livelihood profiles (FEWSNET, 2014). Data for individual households has been collected in many local and larger scale rural studies.

Livelihood patterns

In most agricultural livelihood zones the livelihood pattern approximates that in Fig. 1, i.e., in which income largely depends on a combination of household agricultural production and off farm work, for poorer and middle households chiefly in agricultural and other low paid piece work, for middle households supplemented by retail and other petty trade. The specific sources of household income, their relative importance and the amount and distribution of wealth, income and access to coping opportunities vary widely between zones. The better off engage in larger scale trade and higher value employment. Access to alternative employment varies from none to access to relatively high value labour markets such as South Africa. Wild foods typically make up less than 1% of reference food energy although it remains a substantial potential resource

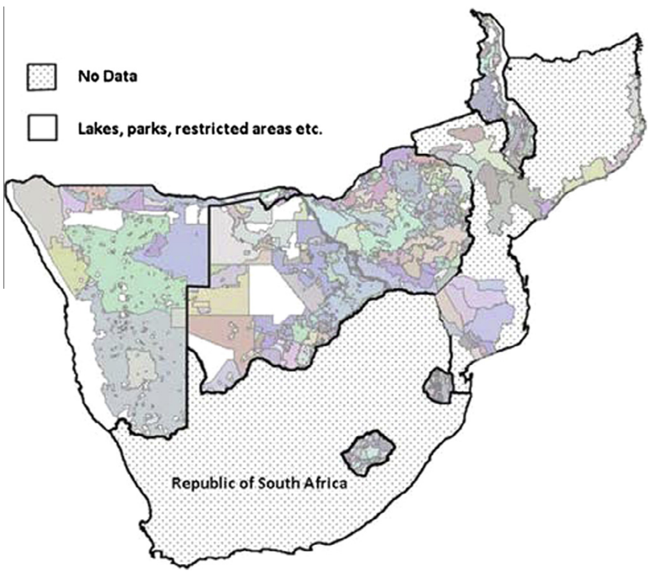

Fig. 2. Map of Namibia, Botswana, Zimbabwe, Mozambique, Malawi, Lesotho and Swaziland showing Livelihood Zones with reference baseline data. Source: SADC/RVAA. Zones in Mozambique approximated from published map. A wider area has been zoned.

in some areas, e.g., parts of southern Sudan. Transfers between households vary from virtually none in some societies, to in others, e.g., Somali areas, a substantial potential income source and insurance against shocks. There are also non-agricultural exceptions, e.g., informal chrome mining in Zimbabwe (Save the Children, 2003).

Current use

In southern Africa, HEA is now used routinely by 9 out of 14 SADC member states for short term food security assessment (mostly annual assessments, with some countries monitoring populations through the 'lean season').

Data to describe shocks and changes is obtained from surveys (e.g. crop surveys) when these are available; where this information is not available, values are estimated from the reference data or local informed judgment supplemented if necessary by additional field data collection. Data is rarely routinely collected by Governments on livestock and fish production, employment or wild foods. In societies where transfers between households are likely to be a significant coping strategy estimates require detailed local knowledge. Acceptable coping strategies, e.g., the acceptable level of livestock sales, are a local policy decision.

Simulations are conducted from early in the year (e.g. during the main crop growing season), on the basis of approximations of the likely crop and other values and refined as better information become available. When there is large uncertainty about a value, e.g., expected food price trajectories, multiple simulations are conducted to establish the range of potential outcomes. The reference data may be adjusted under some conditions, e.g., in some semi arid areas people retain food in years of surplus production, for consumption in years of low production and adjustments may be required to account for fluctuating household food reserves.

Simulations may also be conducted to test the impact of alternative interventions, e.g., food prices can be fixed to simulate the impact of price support. Predictions are sometimes usefully extended to a second year, e.g., widespread thefts of the standing green maize crop during the 2001/2002 Malawi famine reduced the 2002 maize harvest and had a knock on effect on food income later in 2003.

Fig. 3 shows the simulated impact of simple price and production changes on two populations with very different economies and levels of wealth.

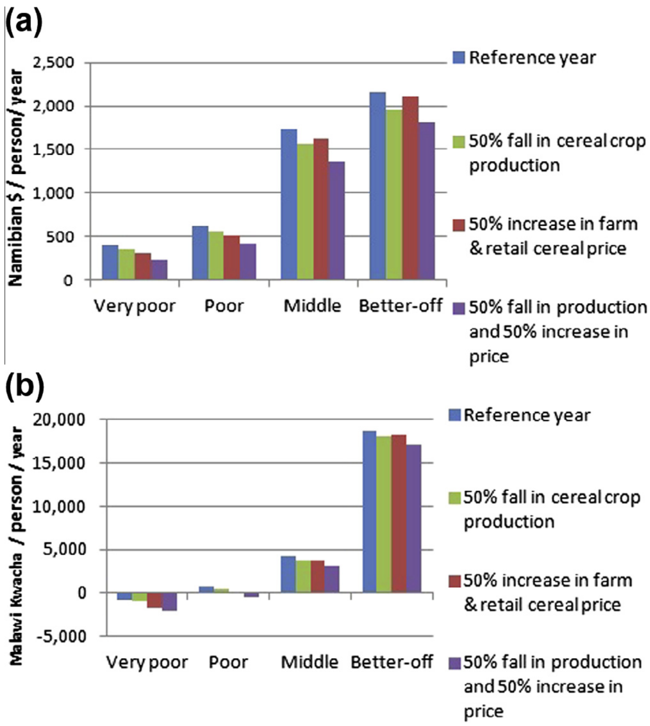

Fig. 3. Simulation comparing the impact of price and production shocks on two livelihood zones. (i) A 50% fall in cereal production. (ii) A 50% increase in farm and retail cereal prices. (iii) A 50% fall in cereal production and a 50% price increase, for: (a) Northern Border Upland Cereal and Livestock Zone, Namibia (data from Fig. 1). (b) A poor population in Salima, Malawi. Values are shown as 'disposable income' (DI)/person/year, i.e., the money remaining/person after the household has met its food requirement (2100 kcal/person/year) from its own production or where this is insufficient by retail purchase. Negative values (e.g. the 'Very poor' in (b)) result when the household has insufficient income to meet its food requirement, i.e., below the 'food poverty line'. The change in DI for each group resulting from a shock depends on their relative dependence for food on their own production and the market. No coping steps, e.g., asset sales, have been included or allowance for non-food purchases. In a. (Namibia) even the very poor have some assets (e.g. a few goats). In (b) (Malawi) the very poor have effectively no alternative income sources.

Data for production changes is often available at a smaller geographic resolution than the livelihood zone. This allows simulation to be conducted at a higher level of geographic discrimination and output obtained at a more local scale. Fig. 4 shows simulations for two projected food price trajectories following a severe harvest failure in output for Malawi, plotted by the enumeration areas (each about 10 sq km) used for the national census.

Interpreting and communicating the results

Interpretation of the importance of an estimated food deficit is essentially a judgement about the potential implications of inaction. This is straightforward for large estimated deficits for populations which barely meet their food requirements even in a reference year, e.g., without intervention the example in Fig. 3 would certainly have led to widespread hunger and distress migration to towns. Even in a 'good' year analysis may reveal areas of need (Government of Malawi, 2007). Predictions may be followed up on the ground to check that these are consistent with actual events.

The results of an assessment are presented as an explanatory narrative connecting the shock and the outcome supported by the results of the quantitative simulation. This ensures that this is accessible to Government, international donors and other non-technical decision makers. The process is institutionalised in the southern Africa region (Supplementary note 4).

Validation

Attempts have been made to validate the model against actual events with entirely positive results (Supplementary note 5).

Discussion and conclusions: applications to climate change

In its current state of development HEA has four main applications to climate change:

1. At a national and regional scale HEA can be used to provide the information required by governments and other agencies to manage the impact of year to year shocks and changes on household poverty and food access to allow action to avoid the erosion of assets and a loss of resilience. HEA is currently used for this purpose, and is likely to be of increasing importance as rainfall becomes more variable, extreme events more frequent and the price of food and other goods increase and become less predictable.
2. To develop scenarios to estimate longer term climate impacts. As with other approaches, long term prediction requires projections of population, livestock, prices and other factors and assumes that patterns of livelihood will remain reasonably stable. Scenarios based on HEA data have been developed to estimate the impact of projected climate change in

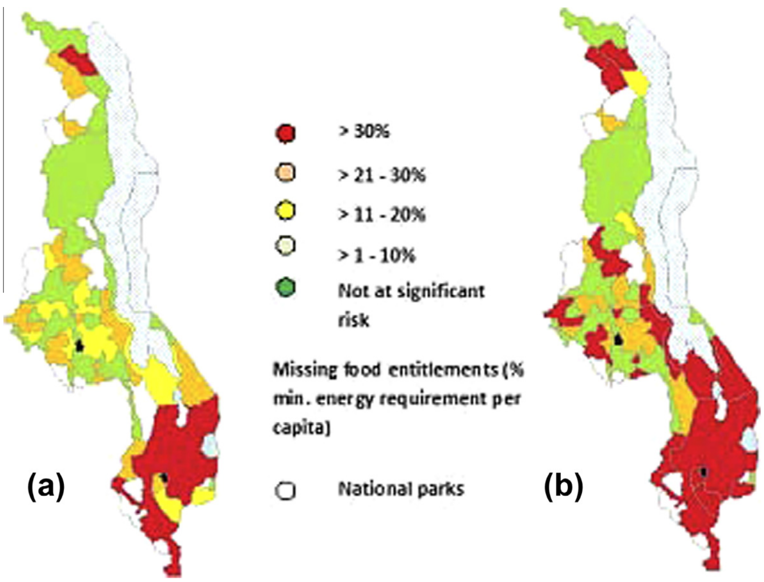

Fig. 4. Two scenarios based on different maize price projections of the impact of a severe maize crop failure in Malawi in 2005 on household food access. The analysis was conducted at a sub livelihood zone level and the output plotted by census enumeration area (approximately 10 sq km) to improve the geographic discrimination. Scenarios are based on: (a) prices adjusted at current average inflation rates (approximately Malawi Kwacha (MK) 21/kg). (b) The projected price of imported maize (approximately MK 36/kg). The analysis was conducted by Charles Rethman. Figure redrawn from published map (Government of Malawi, 2006).

Botswana and Mozambique (Rethman and Hope, 2013) and in Western Zambia (Luxon and Pius, 2012; Venton et al., 2012). Projections for shorter periods (e.g. several years), for which fewer assumptions are required can provide operationally useful insights into the impact of expected climate and other impacts and the potential impact of proposed agricultural, price and welfare interventions.

3. As a source of data on rural livelihoods for use in other applications. For example, the data has been used to compare the relative costs of building the resilience of communities in disaster prone regions to cope with risk and the cost of early and late humanitarian response, and to link food and water security in Ethiopia (Coulter et al., 2011; Government of Malawi, 2006).
4. Lastly HEA and particularly the detailed individual household data offers a framework for collecting reliable quantitative data on household livelihoods for research, e.g., to relate assets and income poverty with land, wild food and other environmental resource use and for operational use, e.g., project planning.

The experience to date demonstrates that it is possible to build large data driven systems of vulnerability assessment, although steps are required to make the data more widely available and to ensure that the system can be sustained in the longer run (Supplementary note 6). Potentially there is scope for developing multi-country or regional models, and for tracking changes in livelihood patterns over time. Further developments will depend on the continuation of the steady investment and technical support required to build national systems and national capacity and collaboration between the many Governments, operational agencies and academic disciplines concerned.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.crm.2014.10.001.

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