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Global Climate Change on Agriculture in India

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ABSTRACT: Our Research Paper "Global Climate Change on Agriculture in India" is an Environment is the essential determinant of rural efficiency. Worry over the possible impacts of long haul climatic change on agribusiness has spurred a significant group of examination over the previous decade. This group of examination tends to conceivable actual impacts of climatic change on horticulture, like changes in harvest and animal's yields, just as the monetary outcomes of these potential yield changes. This paper audits the surviving writing on these physical and monetary impacts and deciphers this examination as far as normal topics or discoveries. Specifically compelling are discoveries concerning the job of human variations in reacting to environmental change, conceivable provincial effects on horticultural frameworks and likely changes in examples of food creation and costs. Impediments and sensitivities of these discoveries are talked about and key spaces of vulnerability are featured. At long last, a few hypotheses in regards to issues of possible significance in deciphering and utilizing data on environmental change and horticulture are introduced drawing primarily on experiences in North and South America. The primary objectives are to review similarities and differences in this research and to identify common themes and lessons. As a part of this identification process, we summarize (1) key findings regarding the role of human adaptations in responding to potential climate change; (2) significant differences in possible regional impacts to agricultural systems; (3) possible distributional consequences (i.e. winners and losers); and (4) potential changes in the level and patterns of food production and prices.

INTRODUCTION

Environment is the essential determinant of horticultural usefulness. Given the essential job of horticulture in human government assistance, concern has been communicated by administrative organizations and others in regards to the likely impacts of environmental change on rural usefulness. Interest in this issue has roused a generous assortment of examination on environmental change and agribusiness over the past decade.

Climate change is relied upon to impact yield and animals creation, hydrologic balances, input supplies and different parts of rural frameworks. Be that as it may, the idea of these biophysical impacts and the human reactions to them are complicated and dubious. For instance, harvest and domesticated animals yields are straightforwardly impacted by changes in climatic factors, for example, temperature and precipitation and the recurrence and seriousness of outrageous occasions like dry seasons, floods, and wind storms. Also, carbon dioxide is essential for plant creation; rising

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focuses have the potential to improve the usefulness of agroecosystems. Environmental change may likewise change the sorts, frequencies, and powers of different yield and animals bothers; the accessibility and timing of water system water supplies; and the seriousness of soil erosion.

Agricultural frameworks are overseen environments. Subsequently, the human reaction is basic to comprehension and assessing the impacts of environmental change on creation and food supply. Farming frameworks are additionally unique; makers and customers are ceaselessly reacting to changes in harvest and domesticated animal's yields, food costs, input costs, asset accessibility, and mechanical change. Representing these transformations and changes is troublesome yet essential to gauge precisely environmental change impacts. Inability to represent human transformations, either as transient changes in utilization and creation rehearses or long haul mechanical changes, will misjudge the possible harm from environmental change and disparage its likely advantages. This review synthesizes research on the physical.

The paper expands on late outlines of farming impacts (Easter ling 1996, IPCC 1996, Schimmelpfennig et al. 1996). Discoveries from the U.S. also Latin America are featured, albeit some broad proof with respect to world farming creation is inspected. Mathematical evaluations introduced here ought to be deciphered as illustrative of the potential outcomes of environmental change, from which more broad, subjective ends may be drawn. Appraisals of changes in agrarian creation are subject to: how environment changes at provincial scales; suppositions with respect to variation by makers and customers; future advancements; populace and pay development; land debasement; macroeconomic conditions; changes in worldwide exchange boundaries; and changes in friendly and political conditions. The outcomes are additionally delicate to the evaluation strategies and models utilized in these assessment exercises.

In Section 2, the biophysical aspects of environment and horticulture are depicted, trailed by a portrayal of variation in the rural framework. Transformation assumes a basic part in deciphering the actual changes in environment and harvest reaction (for example yields) into changes in farming creation, costs, government assistance, exchange and food supply. We feature this job in Section 3 to highlight the issues of variation and change costs, execution imperatives, and vulnerability in both recognizing signs of environmental change and deciding the potential for transformation reactions. Segment 4 sums up the impacts of environmental change on harvest and domesticated animals yields, and surveys the ramifications of those consequences for creation, costs, and monetary government assistance. Segment 5 presents 'examples learned' and a few theories with respect to issues of expected significance in deciphering and utilizing data on environmental change and horticulture.

2. AGRICULTURE AND CLIMATE

Plant systems, and hence crop yields, are influenced by many environmental factors, and these factors, such as moisture and temperature, may act either synergistically or antagonistically with

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other factors in determining yields (Waggoner 1983). Controlled field examinations can produce data on how the yield of a particular harvest assortment reacts to a given improvement, like water or compost. In any case, by their temperament, such controlled investigations consider just a restricted scope of ecological factors.

An elective way to deal with gauge crop yield (changes) is the utilization of harvest biophysical reproduction models that insert boundaries drawn from crop tests (Ritchie et al. 1989). Since environmental change is probably going to cut across a large group of ecological variables, most quantitative assessments of environmental change impacts on crop yields are gotten from such harvest re-enactment models (for example Rosenwein and Parry 1994). While the utilization of harvest reproduction models makes manageable the appraisal of environment impacts across a scope of yields, such models likewise have impediments, including seclusion from the assortment and fluctuation of variables and conditions that influence creation in the field.

Plausible environmental change situations incorporate higher temperatures, changes in precipitation, and higher air CO2 focuses. Despite the fact that temperature increments can have

both positive and adverse consequences on crop yields, by and large, temperature increments have been found to lessen yields and nature of many harvests, above all cereal and feed grains. Expansions in precipitation (for example level, timing and inconstancy) may help semi-parched and other water short regions by expanding soil dampness, however could exasperate issues in locales with overabundance water, while a decrease in precipitation could have the contrary impact. An air with higher CO2 focus would bring about higher net photosynthetic rates (Cure and Acock 1986, Allen et al. 1987). Higher fixations may likewise lessen happening (for example water misfortune) as plants lessen their stomatal gaps, the little openings in the leaves through which CO2 and water fume are traded with the air.

The net change in crop yields is controlled by the harmony between these negative and positive direct consequences for plant development and advancement, and by aberrant impacts that can influence creation. These backhanded impacts have been to a great extent overlooked in the appraisal of environmental change impacts. Backhanded impacts might emerge from changes in the rate and dissemination of nuisances and microbes (Sutherst et al. 1995), expanded paces of soil disintegration and corruption, and expanded tropospheric ozone levels because of rising temperatures (Adams 1986). Extra backhanded impacts might emerge from changes in overflow and groundwater re-energize rates, which influence water supplies, and changes in capital or innovative necessities, for example, surface water stockpiling and water system techniques. As a general rule, these circuitous impacts are not caught in existing appraisals (the special cases are changes in water supplies).

Crop response to climate change

The impacts of environmental change on farming yields differ by area and by crop. Table 1 sums up changes in crop yields assessed in some new examinations in North and South America. All assessments are gotten from biophysical re-enactment models, only the CERES group of yield

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models, for a couple of significant agrarian locales inside chose nations (see Ritchie et al. 1989 for a portrayal of the CERES models).

that may have various weaknesses to environmental change than grain crops. To be sure, it isn't certain that crop re-enactment models created in calm environment zones are suitable for reproduction of harvest yields in tropical areas.

Despite the limits inborn in applying crop recreation models, the examinations do show significant provincial patterns. For instance, Rosenzweig and Iglesias (1994) note that for a 4°C warming and accepting a CO2 compost impact, yields in mid and high scope nations (for example the northern U.S. also Canada) may increment, however yields in low scope nations (for example Brazil) decay. Also, Rosenzweig et al. (1995) observe proof for significant limit impacts. For instance, their outcomes show commonly certain harvest yield reactions to temperature increments of 2°C ascent however

yield decreases at 4°C temperature increments. Different investigations [cited in IPCC (1996) and Smith et al. 1996)] agree that harvest impacts in lower scopes will generally be more negative than crop impacts in higher scopes, especially concerning wheat and maize yields. Rice yields are less factor than wheat and maize yield impacts.

Large spaces of Latin America are impacted by flow climatic interannual fluctuation identified with the length of blustery seasons and the event of outrageous occasions (dry spells, floods, and so on) The couple of studies led in the district to explicitly evaluate the effect of environmental change on farming uncovered decreases in yields and expanded changeability in crop efficiency. For instance, runs of the GISS general dissemination model for quite a long time in Latin America anticipated temperature increments of 3.0 to 4.5°C, and changes in precipitation of – 10 to +30%. The ramifications of this environmental change for 4 Latin American nations demonstrated 10 to 30% harvest yield decreases (Liveryman et al. 1991, Baethgen 1994, de Siqueiros et al. 1994, Sala and Paruelo 1994).

Livestock response to climate change

Animals can likewise be impacted by environment and, thus, environmental change. In particular, animals can be impacted in 2 ways by environmental change: the quality and measure of search from meadows might be impacted and there might be immediate consequences for domesticated animals because of higher temperatures. There are not many examinations which address environmental change impacts on domesticated animals, yet those which do show consequences for execution. For instance, hotter summer temperatures are assessed to have a stifling impact on domesticated animals hunger, which prompts lower weight gain (Adams et al. 1998). In particular, Adams et al. (1998) saw that under a 5.0°C expansion in temperature, animals yield in the U.S. fell by 10% for cow/calf and dairy tasks in Appalachia, the Southeast, the Delta States, the Southern Plains, and Texas; for a 1.5°C warming, yield misfortune was assessed at 1%. Hanson et al. (1993) reproduced impacts on rangeland domesticated animal’s creation under 3 GCM (worldwide environment model) situations. Environmental change would in general unfavourably affect

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domesticated animal's creation (for example low milk creation) through both declining scavenge quality and expanded surrounding temperature. There is proof that seriously oversaw animal's frameworks are possibly more adaptable to climate change than crop systems because they are better able to adapt to extreme events. Some studies of mid to high latitude grasslands found higher productivity under climate change (IPCC 1996).

THE ECONOMIC PERSPECTIVE: DIMENSIONS OF HUMAN RESPONSE

Over the long run, people have adjusted agrarian frameworks and practices to changing financial and states of being. This has been refined by taking on new innovations (remembering speculations for hereditary upgrades), changing harvest blends and developed acreages, and changing institutional courses of action. Such adaptability is reminiscent of critical human potential to adjust to environmental change (CAST 1992, Rosenberg 1992). For instance, ranch level transformations can be made in planting and gather dates, crop turns, choice of yields and harvest assortments for development, water utilization for water system, utilization of manures, and culturing rehearses. These variations are the normal result of makers' objectives of augmenting gets back to their property asset. Every variation can diminish potential yield misfortunes from environmental change and further develop yields where environmental change is valuable. At the market level, cost and different changes can flag further freedoms to adjust. Exchange, both worldwide and international, can redistribute supplies of horticultural items from spaces of relative excess to spaces of relative shortage. In the more drawn out term, expectant transformation may incorporate the turn of events and utilization of new harvest assortments that proposition benefits under future environments, or interests in new water the executives and water system foundation as protection against conceivably less solid precipitation.

Economic approaches to measuring climate change effects

A number of economic approaches and models are found in existing economic assessments. A simple taxonomy of these methods is to classify them as either 'primary' or 'spatial-simple' approaches (Schimmelpfennig et al. 1996). The attributes of each approach are portrayed here.

A underlying methodology is interdisciplinary, utilizing models from a few disciplines to quantify monetary results of environmental change. For instance, the methodology might begin by utilizing crop recreation models (which frequently have a microscale direction of a hectare or more modest) to display yield changes by harvest and afterward by district. This overall methodology consequently straightforwardly consolidates the impacts of environmental change on yield.

These yield reproduction models can be changed in accordance with incorporate the immediate impacts of expanded environmental CO2, and explicit ranch level variation exercises like moving establishing dates, exchanging crops, and adding water system. The quantity of included transformations, for example, adding or upgrading water system, changing yield blends, treatment of harvest 'movement' potential, or changing information blends, differs across studies. Subsequent to estimating crop yield changes under various environments (for example from GCM conjectures), the yield assessments would then be able to be fused into monetary models of the agrarian area to

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gauge changes in grounds and supply by crop and by locale and subsequent changes in market clearing costs. The monetary models look to either limit costs or augment shopper and maker government assistance subject to the climatic and different imperatives forced on the model. This methodology has been applied at the state (Kaiser et al. 1993), territorial (Easter ling et al. 1993), and public level (Adams et al. 1990, 1995, 1998).

The monetary models reflect fluctuating degrees of rancher transformation and change. A test in executing this underlying methodology is to distinguish and consolidate the significant transformations which ranchers may utilize. Since these monetary models additionally normally gauge changes in economic situations under environmental change (market clearing costs), these progressions can be converted into changes in total prosperity of buyers and makers. Such computations are required to comprehend the distributional outcomes of environmental change (for example who gains and who loses).In contrast to the structural models that simulate crop and farmer responses, spatial-analogue models estimate the effects of climate change on horticulture dependent on noticed contrasts in agrarian creation and environment between locales. Spatial-simple models endeavor to draw deductions regarding how cooler locales may embrace practices of hotter districts assuming environment warmed. A key reason is that ranchers will be both capable and able to embrace the cultivating rehearses, crop assortments, and trimming practices of ranchers in hotter regions.

Spatial-simple models can utilize either factual or programming techniques to break down changes in spatial examples of creation; notwithstanding, the two strategies expect costless primary change and variation. Mendelsohn et al. (1994), for instance, utilized a factual way to deal with dissect cross-sectional information of current rural creation across both hotter and cooler locales. They inspected the connection between agrarian land esteems and environment utilizing region level information in the United States. Mendelsohn et al. alluded to their method as the Riparian approach on account of its attention ashore values. In particular, the Riparian approach utilizes relapse methods to assess the impacts of different environment, financial, and different variables on farmland esteems. It evades the issues of understanding express yield and rancher reactions to environment by verifiably expecting that the biophysical and financial changes forced by environmental change will be made consequently (a supposition that can be affirmed today by looking at harvests and practices in hotter environments), a reality normal to all spatial-simple models. The methodology depends on the hypothesis that in cutthroat market economies, land esteem is estimated by the current worth of expected net incomes that are gotten from the most monetarily effective administration and utilization of land.

Conversely, Darwin et al. (1995) created and consolidated a worldwide process able general balance (CGE) model with a geographic data framework (GIS) model to investigate potential environmental change impacts on U.S. horticulture, considering collaborations with non-agricultural areas and other worldwide locales. The GIS part depicts territorial attributes of land,

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environment, water, and horticultural appropriateness. In this methodology, environmental change is expected to move the territorial land class and water attributes, hence modifying the creation opportunities for a given area. The CGE part then, at that point, gauges the subsequent monetary changes and the impacts on provincial and worldwide creation and cost. The strength of spatial-simple methodologies is that underlying changes and rancher reactions are certain in the investigation, liberating the investigator from the weight of assessing the impacts of environmental change on specific area explicit yields and rancher reactions.

These methodologies are likewise engaging concerning the sensibility of spatial transformation as an underlying reaction to environmental change, and to the accessibility of spatially disaggregate information in regards to current horticultural creation, land esteems, and climate. One shortcoming is that the spatial-simple

Adaptation and adjustment of agricultural methodology expects a since a long time ago run harmony that overlooks short-and medium-run change costs. For instance, the spatial-simple model digests from the issues and expenses of changes in primary qualities, for example, water system frameworks that might be important to mirror hotter environment rehearses. The methodology additionally disregards probably changes in result and info costs that outcome from worldwide changes underway and influence ranch level transformation choices. Since market costs (changes) are not estimated, consequences for buyers are not caught. These methodologies additionally expect that ranchers will consequently know how and when to react to environment changes.

For instance, the spatial-simple models can't represent changes coming about because of higher CO2 fixations, which could influence selections of harvests and yield assortments not addressed by the current blend. Timing of reaction is additionally a basic issue in evaluating impacts. Underlying models have the capacity to demonstrate transient changes in environment and in rancher reaction.

LESSONS LEARNED

The above discussion summarizes key biological and economic issues involved in understanding the potential consequences of climate change. It also provides empirical evidence on the potential magnitude of these biological and economic aspects of climate change.

Caution should be exercised in trying to compare numerical estimates across these studies given that crops, reaction data, and expected monetary and natural conditions vary extensively. In any case, the discoveries from these investigations show some normal patterns and sensitivities to forced conditions and to information exactness and precision. These normal qualities or 'illustrations learned' can serve to both sum up the significant discoveries emerging from existing examination and to help bound the elements of the scientific and observational issues in ongoing appraisals.

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A portion of these normal discoveries follow straightforwardly from 'first standards' of natural or financial science; others are more inconspicuous and emerge from the attributes of the farming setting. Together, they reflect current comprehension of the monetary outcomes of environmental change for agriculture.

The joined impacts of warming, precipitation change, and CO2 treatment on crop yields are relied upon to differ by crop, area, the size of warming, the bearing and size of precipitation change, and the idea of the CO2 preparation impact. Expanding temperatures, holding different elements consistent, diminishes crop yields while expansions in precipitation reduce or offset this outcome. Consideration of assessed impacts of expanding convergence of CO2 on crop yields (for example a preparation impact) essentially raises the yields of many harvests.

There are probably going to be local victors and losers from environmental change, considering that the potential for net decreases in crop yields is most prominent in hotter, low scope regions and semi-parched spaces of the world. This suggests that environmental change might influence the similar benefit of farming creation locales. Changes in near benefit can be anticipated to move topographically the regions in which explicit harvests are developed, both inside nations and universally, influence rural incomes of various areas and nations, and modify examples of exchange rural products among districts and countries.

The financial outcomes of any yield changes will be impacted by variations made by ranchers, shoppers, government organizations, and different establishments. Ranchers might adjust by changing establishing dates, subbing cultivars or harvests, changing water system rehearses, and changing area allotments to trim creation, field, and other uses.

Consumers might adjust by subbing moderately low valued items for those that become somewhat extravagant because of the impacts of environmental change. Consideration of such versatile reactions is basic to a legitimate evaluation, considering that these reactions bring about less unfriendly impacts than in case such reactions are avoided, and in certain investigations even opposite the bearing of the net financial impact (from negative to positive).

Although transformations are featured by much ofthe ongoing writing, variation suspicions are not by any means the only element adding to the separating results among underlying and spatial-simple methodologies. Disparate outcomes additionally reflect contrasts in the capacity of the models to represent both central biophysical connections, like CO2 preparation and fundamental harvest yield reactions to climatic changes, and the limit of no climatic assets, for example, soil quality and dampness accessibility, to help changes in the area of horticultural practices. Some examination proposes that goal of these vulnerabilities might further develop financial appraisals more than extra tweaking of variation assumptions.

Difficulties in surveying transformation responses, from the point of view of upgrading primary models, are compounded by the somewhat expansive and level disseminations of emotional probabilities related with conceivable environment changes suggested by different environment

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models. Until there is more prominent goal as for assessed changes in precipitation and water accessibility, conceivable ranch level reactions will remain exceptionally theoretical and restricted to over-simplifications. Moreover, proceeded with broad vulnerability about conceivable precipitation changes will normally defer and repress capacities to identify since quite a while ago run shifts in environment (for example among ranchers); may sabotage support for examination, instruction, and expansion as an expectant reaction to environmental change; and diffuse help for alleviation reactions.

Changes that are harmful for consumers are typically beneficial to producers.

In several studies of U.S. agriculture that include price effects, reductions in crop yields indicate that consumers would follow through on greater expenses and get more modest amounts of rural products, and would subsequently experience financial misfortunes. Notwithstanding, on the grounds that buyer requests for most yields are generally inelastic concerning cost, decreases in supply result in much more noteworthy rate expansions in costs. Subsequently, cultivators are projected to acquire on normal from income expansions in these situations (despite the fact that producers in areas that experience especially extreme yield decreases might experience financial misfortunes). The financial consequences for customers are diffused over a lot bigger populace than are maker impacts, yet in total the impacts are of generally comparative magnitude.

Agriculture is a worldwide framework, connected through trade streams in products, sources of info, innovation, and information. In this manner, nation and locale explicit examinations can just give halfway and inadequate points of view on likely effects. Just with an all around the world comprehensive methodology, in which provincial reactions are adapted by worldwide changes underway and cost, would researchers be able to start to recognize unmistakably the course and extent of effects for a particular area and country. Without simultaneous endeavors to work on worldwide displaying, ongoing IPCC endeavors zeroing in on more noteworthy spatial disaggregation are possibly self-limiting.

Changes in environment are relied upon to influence the efficiency and total interest for elements of creation like water, work, energy, hardware, and materials. Environmental change is undifferentiated from innovative change in farming which can increment or lessening the complete efficiency of elements aggregately and can increment or abatement the usefulness of one element comparative with another. Most investigations for the U.S. demonstrate that efficiency changes set off by environmental change would create changes in developed grounds by crop, absolute developed land, water system water utilization, ranch business and different changes in factor requests. The results of changes in factor requests on local or nearby economies are to a great extent neglected however are conceivably significant. Estimates of the regional effects of

The climatechange on farming are profoundly factor as for the environmental change suspicions being assessed. Due to this reliance, and in light of the fact that adjustments of local environment

can't be anticipated with a serious level of certainty, accessible evaluations of impacts can't be depended upon as forecasts of effects on horticulture. The contingent projections found in the writing offer, all things being equal, delineations of potential results which can support the evaluation of the affectability and weakness of horticultural frameworks to environmental change. (10) Recent exploration has progressed comprehension of the affectability and weakness of agrarian frameworks to environmental change, yet there are as yet various significant exclusions in appraisals of effects. Roundabout impacts of environmental change, for example, changes in the frequency and seriousness of farming bugs and illnesses and changes in soil disintegration are to a great extent obscure and have not been fused into evaluations of effects. Hardly any investigations consider the impacts of changes in the frequencies of outrageous occasions like dry spells and floods, or changes in climatic inconstancy. Expenses and impediments to transformation have additionally been excluded. These excluded impacts are conceivably significant for molding the full effects of environmental change on agribusiness.

CONCLUSIONS

Inside the U.S. furthermore the remainder of the Americas, there will be the two champs and failures, for certain spaces profiting from expansions in farming creation because of environmental change while different regions endure diminishes. Environmental change may likewise influence the government assistance of monetary gatherings in an unexpected way (for example customers versus makers). Generally speaking, nonetheless, the agreement of monetary evaluations is that environmental difference in the extents presently being talked about by IPCC and different associations will have just a little (logical constructive outcome) on U.S. agriculture.

On a worldwide scale, the provincial increments and diminishes related with environmental change are not relied upon to bring about huge changes in food creation over the course of the following century. In any case, impacts on provincial and nearby food supplies in some low scope districts could add up to enormous rate changes in current creation. Environmental change may consequently force massive expenses on these spaces. Also, warming past that reflected in current investigations might force more noteworthy expenses as far as total food supply. Projections from most monetary examinations show significant financial misfortunes as temperature increments past what could be compared to a CO2 multiplying. This supports the need to decide the greatness of warming which might go with the CO2 development at present under way in the air.

LITERATURE CITED

1. Adams RM (1986) Agriculture, forestry and related benefits of air pollution control. Am J Agric Econ 68:885–894
2. Adams RM, Glyer JD, McCarl BA, Dudek DJ (1988) The implications of global change for western agriculture. West J Agric Econ 13:348–356

3. Adams RM, Rosenzweig C, Ritchie J, Peart R, Glyer J, McCarl B, Curry B, Jones J (1990) Global climate change and U.S. agriculture. Nature 345:219–224
4. Adams RM, Fleming RA, Chang CC, McCarl BA, Rosenzweig C (1995) A reassessment of the economic effects of global climate change on U.S. agriculture. Clim Change 30: 147–167
5. Adams RM, McCarl BA, Segerson K, Rosenzweig C, Bryant KJ, Dixon BL, Conner R, Evenson RE, Ojima D (1998) The economic effects of climate change on U.S. agriculture, Chap 2. In: Mendelsohn R, Neumann J (eds) The economics of climate change. Cambridge University Press, Cambridge (in press) Allen LH Jr, Boote KJ, Jones JW, Jones PH, Valle RR, Acock B, Rogers HH, Dahlman RC (1987) Response of vegetation to rising carbon dioxide: photosynthesis, biomass and seed yield of soybean. Global Biogeochemist Cycles 1:1–14 Alston JM, Norton GW, Pardey PG (1995) Science under scarcity: principles and practice for agricultural research evaluation and priority setting. Cornell University Press, Ithaca, NY Antle JM (1987) Econometric estimation of producers' risk attitudes. Am J Agric Econ 69(3):509–522.

Baethgen WE (1994) Impact of climate change on barley in Uruguay: yield changes and analysis of nitrogen management systems. In: Rosenzweig C, Iglesias A (eds) Implications of climate change for international agriculture: crop modeling study. EPA 230-B-94-003. U.S. EPA Office of Policy, Planning and Evaluation, Climate Change Division, Adaptation Branch, Washington, DC, p 1–13.

CAST (Council for Agricultural Science and Technology) (1992) Preparing U.S. agriculture for global climate change. Task Force Report No. 119. Council for Agricultural Science and Technology, Ames, IA CNSCG (Commission Nacional Sobre el Cambio Global, Uruguay) (1997) Draft final report. Uruguay climate change country study: assessment of climate change impacts in Uruguay. March. CNSCG, Montevideo Assessments: Impacts and Responses, March 25–28, San Jose, Costa Rica