



IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN DEVELOPING COUNTRIES

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Abstract

The effect of climate alternate on agriculture will help to make clear the belief of the trouble and quantify the impact, contributing to the method of sustainable livelihoods. This take a look at uses the Ricardian approach to explore the implications of weather trade on agriculture within the North western region of Vietnam by taking farmer adaptations under consideration. The largest regarded monetary effect of weather exchange is upon agriculture due to the dimensions and sensitivity of the sector. Warming reasons the greatest damage to agriculture in developing countries normally due to the fact many farms inside the low latitudes already undergo climates which are too hot. This paper critiques numerous research that measure the size of the effect of warming on farms in growing countries. Even although edition will blunt some of the worst expected consequences, warming is predicted to motive massive damages to agriculture in developing countries over the subsequent century

Keywords: climate, change , agriculture , developing , countries

Introduction

Climate exchange is probably to make contributions considerably to meals lack of confidence inside the future, with the aid of increasing meals expenses, and decreasing food manufacturing. Food may additionally become greater highly-priced as weather change mitigation efforts growth electricity charges. Water required for food manufacturing can also grow to be extra scarce due to increased crop water use and drought. Competition for land may also boom as sure areas turn out to be climatically flawed for production. In addition, extreme climate events, related to climate change can also cause surprising reductions in agricultural productivity, leading to rapid rate will increase. For instance, warmth waves inside the summer of 2010 brought about yield losses in key manufacturing areas including: Russia, Ukraine and Kazakhstan, and contributed to a dramatic boom within the fee of staple foods. These rising costs compelled growing numbers of neighborhood human beings into poverty, supplying a sobering demonstration of the way the influence of climate change can bring about meals lack

of confidence. The consensus of the Intergovernmental Panel for Climate Change (IPCC) is that sizable weather alternate has already happened since the Nineteen Fifties, and that it's possibly the global imply floor air temperature will increase with the aid of zero.4 to two.6°C inside the 2d half of of this century (relying on destiny greenhouse gasoline emissions). Agriculture, and the wider meals production machine, is already a first-rate source of greenhouse gas emissions. Future intensification of agriculture to compensate for reduced production (partly resulting from climate change) alongside an growing demand for animal products, should similarly increase these emissions. It's anticipated that the demand for cattle products will grow by way of +70% between 2005 and 2050.

The importance of information the continued effect of weather change on agriculture is frequently underestimated. Domestic coverage issues require that climate alternate be factored into improvement sports which are motivated through the weather and weather. At the identical time, medical reviews of the immediacy of the effect of weather trade

and the extent of weather vulnerability are crucial to the method of country wide negotiating positions at international weather-alternate negotiations. An early and equitable worldwide agreement on weather trade is beneficial to much less-evolved nations, but the query of how a lot delay by way of advanced nations they can tolerate in this problem is of vital strategic hobby to them.

Much of the priority approximately weather exchange stems from inferences primarily based on hooked up and ongoing technology, in place of from direct evidence of its modern-day effect. We therefore provide a brief account of strategies of estimating the future effect of climate variability on agriculture. Additionally, in the case of India, we offer a summary of the clinical evidence for expected biophysical and different factors of the impact of climate change on agriculture (see annotated bibliography). The financial impact of weather change, specifically for less-developed countries and particularly in sectors like agriculture, is of paramount importance. Existing estimates of such monetary impact, but, are even more tenuous than those of bodily impact. We in brief describe and examine some prevalent techniques of estimating the monetary effect of climate trade on agriculture. The unimpeded boom of greenhouse fuel emissions is elevating the earth's temperature. The results encompass melting glaciers, extra precipitation, more and more extreme weather events, and moving seasons. The accelerating pace of weather alternate, mixed with international populace and earnings increase, threatens food security everywhere. Agriculture is extraordinarily at risk of weather alternate. Higher temperatures sooner or later lessen yields of ideal crops whilst encouraging weed and pest proliferation. Changes in precipitation styles growth the likelihood of brief-run crop failures and long-run manufacturing declines. Although there might be profits in some plants in a few regions of the world, the overall affects of weather alternate on agriculture are expected to be poor, threatening

worldwide food protection. Populations inside the developing world, which are already prone and food insecure, are probable to be the most severely affected. In 2005, nearly half of of the economically lively population in developing countries—2.5 billion people—depended on agriculture for its livelihood. Today, 75 percentage of the arena's terrible live in rural areas.

This Food Policy Report gives studies outcomes that quantify the climate-exchange impacts noted above, assesses the results for food safety, and estimates the investments that might offset the bad effects for human nicely-being.

Design and implement good overall development policies and programs.

Given the current uncertainty approximately region-unique outcomes of weather alternate, good improvement guidelines and programs also are the exceptional weather-alternate version investments. A pro-growth, pro-terrible improvement schedule that supports agricultural sustainability also contributes to meals safety and climate-exchange edition in the growing world. Adaptation to weather exchange is simpler while people have more resources and perform in an monetary environment that is bendy and responsive.

Increase investments in agricultural productivity.

Even with out weather exchange, extra investments in agricultural technological know-how and technology are had to meet the needs of a global population predicted to reach nine billion via 2050. Many of these people will live in the developing world, have higher incomes, and preference a extra various food regimen. Agricultural technology- and generation-based totally solutions are crucial to satisfy the ones needs. Climate alternate locations new and greater difficult demands on agricultural productivity. Crop and farm animals productiveness-improving studies, which include biotechnology, can be essential to help triumph over stresses due to weather exchange. Crops and livestock are needed that are doing reasonably well in more than a few manufacturing environments

rather than extremely nicely in a narrow set of climate situations. Research on nutritional changes in food animals and modifications in irrigation-control practices is wanted to lessen methane emissions.

Reinvigorate national research and extension programs.

Investment in laboratory scientists and the infrastructure they require is wanted. Partnerships with other country wide systems and global facilities are part of the answer. Collaboration with local farmers, enter providers, traders, and customer groups is also critical for powerful improvement and dissemination of domestically appropriate, value-effective techniques and cultivars to help revitalize communications among farmers, scientists, and different stakeholders to meet the demanding situations of climate change.

Improve global data collection, dissemination, and analysis.

Climate alternate will have dramatic effects for agriculture. However, sizable uncertainty stays about in which the results might be finest. These uncertainties make it tough to transport ahead on policies to fight the effects of climate trade. Global efforts to gather and disseminate records on the spatial nature of agriculture want to be bolstered. Regular, repeated observations of the floor of the earth via faraway sensing are crucial. Funding for country wide statistical programs must be expanded that will satisfy the mission of tracking worldwide trade. Understanding agriculture–climate interactions properly sufficient to support variation and mitigation activities based totally on land use requires predominant upgrades in facts series, dissemination, and evaluation.

Objectives of the Study

1. To study on Increase investments in agricultural productivity.
2. To study on Reinvigorate national research and extension programs.

Research Methodology

Studies with Aggregate Data

Empirical monetary researches of agriculture in developing nations have

been rare due to the absence of appropriate information. Existing economic statistics in many nations simply became no longer dependable. For example, cutting-edge estimates of the amount of cropland in Africa range via a thing of (Lotsch, 2006).

The first financial research of weather exchange focused on Brazil and India precisely because both of these international locations stored exact agricultural information (Mendelsohn & Dinar, 1999; Kumar & Parikh, 2001; Mendelsohn et al., 2001). Using the Ricardian method advanced by way of Mendelsohn et al. (1994), those research tested the common net revenue (India) and land cost (Brazil) in every district or municipio, respectively. Net sales measured in rupees in line with hectare in line with yr became used in India become used due to the fact land values had been now not to be had there. In wellknown, land values are less complicated to examine because they mirror the long term productiveness of the land. Net revenues capture the once a year productiveness and may be prompted with the aid of many factors which might be ordinary to a given 12 months such as the weather. In the India take a look at, only internet sales in line with hectare turned into available and in order that turned into used as the dependent variable. In Brazil, each internet sales and land value have been available and each were tested. However, the land price facts brought about extra regular and vast consequences. One must be careful in evaluating land values to internet revenues to take into account that land values are the present value of all future net revenue. In fashionable, land values are approximately 20 times larger than annual internet sales. The coefficients on a regression with land price are therefore anticipated to be approximately 20 times larger than a comparable regression using net revenues.

The Ricardian research in Brazil and India discovered that agriculture in each nation would be sensitive to even modest warming. Because the Ricardian technique takes variation under

consideration, those first analyses suggested that there might be residual harm in those nations despite version. Even marginal will increase in temperature could result in reductions in average net revenue and land value. The analyses additionally revealed, but, that now not every farm in those international locations might be affected the identical. The moist japanese area of India would mildly benefit from warming whereas the dry western area of India might go through large damages. The southeastern location of Brazil might advantage whereas the Amazonian and northeastern place of Brazil would be hurt.

One exciting technical question posed through studying agriculture in developing countries is that existing weather may be hard to degree. Although climate stations take correct recordings of climate through the years (climate), the stations are regularly broadly dispersed and focused in towns. Farms, due to the fact they are positioned in rural settings, may be pretty remote from the closest weather station. The Ricardian studies consequently relied on assets of weather statistics. Temperature turned into measured the use of satellites. The gain of satellites is they can take direct measurements of the entire earth, specifically of temperature. One of the disadvantages of satellites is they cannot measure the whole thing of significance, especially precipitation. In order to acquire precipitation measures, it becomes important to interpolate between climate stations. This combination changed into determined to provide the most dependable climate.

Another subject matter that becomes investigated in that research changed into whether or not farms have been extra responsive to weather normals or climate variance. The weather normal is the suggest weather over a 30 year duration. The weather variance is the interannual variation around that imply over that same length. Studies that have tested each normals and variance have observed that each measure is vital. Increased interannual variance in spring and summers reduce land price. Increased

interannual variance inside the iciness, however, increases land value. Whereas farmers can adapt to located changes in winter climate via planting distinctive plants and converting the timing of the subsequent developing season, there are fewer modifications that may be made at some stage in the growing season to the climate that unfolds.

Data Analysis

Impact Studies with Individual Farm Data

The absence of neighborhood monetary records is a severe hindrance to engaging in climate research in maximum growing international locations. One way to conquer this drawback is to accumulate facts on man or woman farms across a huge range of climate zones. This section describes a new wave of studies this is primarily based on samples of farms collected exactly to observe climate alternate. The sampling become designed to study international locations in extraordinary weather zones and to choose farms inside every USA. Across a wide variety of climate zones. The survey tool become designed to degree annual internet sales in locations without land markets and land values while viable. The tool accumulated statistics approximately the selections that farmers made: This plants to plant, which farm animals to elevate and which inputs to purchase. Data turned into amassed approximately inputs, outputs and expenses (see Dinar, et al., 2008 for a duplicate of the survey tool). This data changed into blended to estimate gross revenues and charges. Net sales had been calculated by means of subtracting fees from gross revenues. Information from different sources became gathered on weather, soils and other manage variables after which merged with the economic information.

The first set of impact research with person farm statistics become undertaken in Africa. The GEF and World Bank financed a take a look at of 11 African international locations (Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Niger, Senegal, South Africa, Zambia and Zimbabwe).

A survey device become designed and tested for Africa. Teams from each country amassed statistics the usage of this device across a extensive range of African weather zones. Over 10 000 farmers were interviewed approximately their cattle and crop incomes, costs and farming picks. The financial facts became matched with weather records from satellites and climate stations. Soils statistics turned into accumulated from FAO (2003).

A Ricardian analysis was undertaken to measure the impact of climate on present day net revenues. In many places in Africa, land markets had been not sufficiently fashioned to provide land values. Three regressions are displayed in Table 1. The first regression indicates the relationship between net

revenues and weather and soils for all farms. The 2d regression appears at most effective dryland farming. The third regression appears at most effective irrigated farms. All 3 regressions monitor that both temperature and precipitation play a position in determining internet sales in keeping with hectare. All 4 seasons are vital and the impacts of every season are special. The climate effects are nonlinear. The climate coefficients aren't the identical in each regression. Climate has a one of a kind impact on dryland as opposed to irrigated farms. Other variables that are essential include the waft of water into the district, the dimensions of the farm, the elevation, availability of strength and numerous soil kinds

Table 1: African regression of crop net revenue of all farms, rain-fed farms, and irrigated farms with regional dummies

Variable	All farms	Rain-fed	Irrigated
Winter temperature	-173.6**	-106.7	-93.5
Winter temperature squared	6.1**	3.9*	4.9
Spring temperature	115.1	-82.8	58.7
Spring temperature squared	-5.0**	-0.3	-4.1
Summer temperature	173.9**	198.6**	827.5**
Summer temperature squared	-1.9	-3.2*	-13.1*
Fall temperature	-98.1	-92.4	-824.2*
Fall temperature squared	1.1	1.5	15.3*
Winter precipitation	-2.9*	-1.9	5.8
Winter precipitation squared	0.0**	0.00	0.00
Spring precipitation	3.5*	3.6**	-10.6
Spring precipitation squared	-0.001	-0.011*	0.091*
Summer precipitation	3.4**	1.9*	21.4**
Summer precipitation squared	-0.012**	-0.005	-0.086**
Fall precipitation	-0.5	-0.6	-14.7**
Fall precipitation squared	0.0055*	0.0053*	0.0586**
Mean Flow	9.4**	-5.4	8.8**
Farm area	-0.1**	-0.3**	-0.0**
Farm area squared	0.0*	0.0**	0.0*
Elevation	0.035	-0.0009	0.229
Log(household size)	22.9	10.1	62.4
Irrigate(1/0)	237.5**		
Electricity (1/0)	66.6**	47.7**	233.2*
Eutric Gleysols— <i>Coarse, Undulating</i>	-631**	-287**	-540
Lithosols and Luvisols— <i>Hilly to Steep</i>	-387**	-156**	-1147**
Orthic Luvisols— <i>Medium, Hilly</i>	-2181**	-1959**	
Chromic Vertisols— <i>Fine, Undulating</i>	-1180**	-1006**	-1719**
Chromic Luvisols— <i>Medium to Fine, Undulating</i>	-295**	-241**	
Cambic Arenosols	1633**	1726**	
Luvic Arenosols	-482**	-188**	
Chromic Luvisols— <i>Medium, Steep</i>	-2153		-6157**
Dystic Nitosols	214		7051**
Gleyic Luvisols	-199**	-154**	
Rhodic Ferralsols— <i>Fine, Hilly to Steep</i>	1428**		3212
Calcic Yermosols— <i>Coarse to Medium, Undulating to Hilly</i>	1071**	148	
West Africa dummy	136**	208**	-285
North Africa dummy	457**		675*
East Africa dummy	-186**	-154**	-361
Heavy machinery dummy	51.8**	55.5**	-60.8
Animal power dummy	10.4	49.3**	-185.5**
Constant	-388	1081	-549
N	8459	7238	1221
R2	0.4	0.2	0.3
F	63.6	32.4	46.3

Table 2: Marginal climate impacts on African crop net revenue

Annual	Africa regression	Irrigated regression	Rain-fed regression
Temperature (\$/ha/°C)	-28.5**	+35.0	-26.7**
Precipitation (\$/ha/mm/mo)	+32.8**	+38.2	27.0**

Table 3: Two equation model of climate impacts on African livestock

Variables	Value of stock of livestock (\$/farm)		Net revenue per unit of stock	
	Coefficient	T-stat.	Coefficient	T-stat.
Intercept	12460	1.86	1424	6.72
Temperature \times small ¹	-1049	-1.71	-49.9	-2.53
Temperature sq \times small ¹	28.2	2.10	0.55	1.28
Precipitation \times small ¹	-103	-2.98	-13.41	-12.05
Precipitation sq \times small ¹	0.47	2.60	0.07	13.17
Temperature \times large ¹	1351	7.15	14.90	2.43
Temperature sq \times large ¹	-42.8	-7.21	-0.50	-2.59
Precipitation \times large ¹	-7.62	-0.20	-2.67	-2.19
Precipitation sq \times large ¹	-0.32	-1.47	0.01	1.07
Log household size	-2240	-4.55	10.57	0.66
Electricity dummy	4960	7.13	219.5	9.72
Population density	126.6	2.77	11.55	7.96
Population density sq	-2.13	-4.21	-0.12	-7.79
% Muslim	-4508	-3.02	-31.75	-0.75
% Grassland	22952	10.58		
R-squared	0.20		0.20	
Observations	4763		4763	

Notes: 1 Climate variables were multiplied by farm size dummy to measure farm size specific climate impacts. From Seo and Mendelsohn, 2008a.

In order to examine consequences throughout nations, neighborhood foreign money values had been all converted to USD using foreign exchange charges. Examining the marginal impact of warming, Table 2, a one diploma (C) boom in temperature could lessen common net sales consistent with hectare through -\$28 (or -6%). Looking at just dryland farmers, the marginal temperature impact is -\$27 (-eight%). Finally, looking at irrigated farms, the marginal temperature impact is +\$35 (+three%). Warming is harmful to rain-fed farming but absolutely beneficial to irrigated farms. The marginal impact of a 1 cm/mo increase in precipitation is to growth farm net sales with the aid of +\$33 (+7%) on average. Net revenues on rain-fed farms increase through +\$27 (+eight%) and on irrigated farms they growth through +\$38 (+three%). Rain-fed and irrigated farms each benefit (lose) if rainfall increases (falls). In addition to reading vegetation, the African look at additionally examined the internet sales from cattle.

The amount of land used for cattle is hard to degree due to the fact most farmers graze their animals on not unusual land. Instead of analysing net

revenue in keeping with hectare, the livestock analysis examines internet revenue in step with farm. This decision is broken down into picks. First, the farmer should decide how many animals of each kind to own. This is a stocking query. The stock is calculated with the aid of multiplying the range of animals instances the average market rate for each species. Note that the farmer does no longer manipulate the fee in line with animal. The stocking query depends at the net sales consistent with unit animal. This ratio is the yearly net revenue in line with greenback of stock owned. The greater effective is the stock, the higher is this ratio and the more stock the farmer is going to want to personal. In order to estimate this model, a -degree regression is anticipated. The cost of farm animals owned is first regressed on weather and other site traits. The fraction of grassland inside the district (an environment degree) identifies the choice. In the second regression, a profit according to animal is regressed on climate and a few manipulate variables. The model additionally distinguishes between small and massive farms. Size, in this case, was determined by means of the price of cattle owned.

Climate variables had been interacted with a dummy variable for small and large farms for you to estimate their individual climate sensitivity. The

consequences of this two stage model are shown in Table 3. Climate variables are considerable determinants of both how many animals farmers own as well as the net revenue in keeping with unit stock. The weather coefficients for small and massive farms aren't the identical. The weather response is nonlinear. Smaller households, a decrease percentage of Muslims, strength, higher population densities and grasslands all led to higher shares. Larger families, a decrease percentage of Muslims, better populace densities and grasslands all brought about better earnings according to unit stock. The position of some of these control variables together with the percentage of grasslands are smooth to interpret—they mirror the productiveness of the ecosystem for animals. Other control variables are greater tough to interpret. For example, it isn't clean whether strength increases the productivity of animals or whether it is correlated with a lacking variable which include proximity to towns that make large shares extra profitable. Similarly, it isn't always clean why the percentage of Muslims is enormous in those regressions.

Conclusion

This paper describes several new studies that measure the monetary impact of climate trade on agriculture in developing countries. The research affirm some in advance hypotheses and show that different hypotheses had been fake. The studies generally verify the speculation that tropical and subtropical agriculture in growing nations is more climate touchy than temperate agriculture. Even marginal warming reasons damages in Africa and Latin America to plants. Crops are also sensitive to modifications in precipitation. In semi-arid locations, elevated rainfall is useful. However, in very wet locations, increased rainfall may be dangerous. If climate scenarios grow to be fairly hot and dry, they may cause a number of harm to farms in low range nations. However, if climate eventualities come to be exceptionally slight and moist, there may be most effective modest damages and perhaps even useful results. The

magnitude of the damage relies upon greatly at the climate situation. Small farmers aren't necessarily extra susceptible than large commercial farmers. The cattle look at in Africa found that small family incomes could upward push with warming whereas industrial incomes could fall. Small cattle farmers have many alternatives to interchange vegetation and farm animals that seem to lead them to much less inclined than commercial cattle operations which might be greater specialized. The examine in South America located that small farmers are not any much less sensitive to warming than huge farmers. Within growing international locations, small farmers can be less susceptible than commercial farmers. Irrigation appears to be a completely powerful tool to counteract the damaging outcomes of either warming or drying. The incomes of irrigated farms are usually less at risk of warming than rain-fed farms and may even increase with warming. For example, irrigated farms in Africa and China are plenty less at risk of warming than rain-fed farms in the ones identical international locations. However, it's far critical to understand that irrigation is limited by way of the provision of water. If climate exchange reduces water materials and will increase water demand, water may also end up scarcer. Farmers may additionally nicely find that they can't pay for or achieve the water they might want to irrigate. Farmers can be compelled to switch from irrigated to rain-fed acreage. It could be very essential that analyses of agriculture in regions relying upon or thinking about irrigation have a look at watershed control as part of their evaluation of the agriculture zone. There were some pioneering research of weather and water however they are nevertheless rare (Strzepek et al., 1996; Hurd et al., 1999; Howitt & Pieneer, 2006; Lund et al., 2006). The analysis in this paper examines the weather sensitivity of present day farms. In order to challenge the influences of climate inside the destiny, it is necessary to mission how agriculture will exchange over time. It is destiny farms a good way to revel in

future climates. Technical change, improved capital, improved get right of entry to and feasible adjustments in policy ought to all be taken into consideration. How will climate trade have an effect on these destiny farms? Finally, it's far critical to be aware that the impacts of weather exchange aren't going to be the same for every growing us of a or even for each vicinity interior a rustic. The analysis indicates that the influences will rely greatly on contemporary local climate, how climate locally adjustments, and different situations of each location inclusive of marketplace get right of entry to and soil conditions. Some developing international locations with temperate climates might also nicely gain from warming. Some nations may discover they obtain needed rains inside the future climate scenario. Some international locations may also nicely have excellent substitutes for modern sports that keep them from critical harm. Other international locations could be a great deal less lucky. They may additionally suffer huge temperature increases, lose needed rain, or be not able to adapt. It is critical when addressing programs to assist countries with climate alternate to take note of what specific issues they're having and what movements could provide the best long-time period comfort.

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