LEVERAGING AGRICULTURE FOR IMPROVING NUTRITION & HEALTH

2020 Conference Paper 1 • February 2011

THE NEXUS BETWEEN AGRICULTURE AND NUTRITION

DO GROWTH PATTERNS AND CONDITIONAL FACTORS MATTER?

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2020 Conference Paper 1

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2020 Conference: Leveraging Agriculture for Improving Nutrition and Health
February 10-12, 2011; New Delhi, India

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Contents

The Nexus between Agriculture and Nutrition

Do Growth Patterns and Conditional Factors Matter?

Shenggen Fan and Joanna B...

1. Introduction

Adequate nutrition is a basic human need. Individuals must consume sufficient amounts of not only calories, b... support growth and development. Although tremendous progress has been made in meeting the world's food d... continue to suffer from undernutrition—that i... vitamins and minerals. A number of indicators can be use... (Box 1). Although undernutrition can occur at any... deficiencies among children (particularly th... severe and even permanent damage (Ruel and Hoddinott 2008).

> **BOX 1 — Indicators o... status**
>
> ... : deficiencies in ... consumption of calories ... vitamins and minerals ... based on food purchase...
>
> ... nutritional outcomes: Body mass ... for adults, and stuntin... age), wasting (low we... and underweight (low w... for children.

economic growth, which many a... impact on nutritional status t... expenditures, has not transla... of developing countries. For ... economic growth in recent yea... (GDP) growing at an annual rat... home to approximately 42 perc... children. The disconnect betw... tion is often referred to as a "... Inadequate nutrition can be ... interactive factors at the int... nity, household, and individu... which sector or subsector is driving growth matters... part of overall economic growth, agricultural grow... tant role to play in reducing and preventing undern... from increasing household ability to purchase and ... such as increasing government revenues to fund edu... programs. However, questions remain about the effects of d... Furthermore, factors such as infrastructure, the s... distribution also contribute to how well agricultur...

This paper seeks to provide an overview of the c... growth, examine how different growth patterns lead t... that influence the magnitude of this relationship. I... research and analysis and to provide policymakers ... and investment policies that will increase the lik...

2. Does Growth Matter?

Although many studies have analyzed the impact of ... ental work by Fogel (1994)—few studies have tried ...

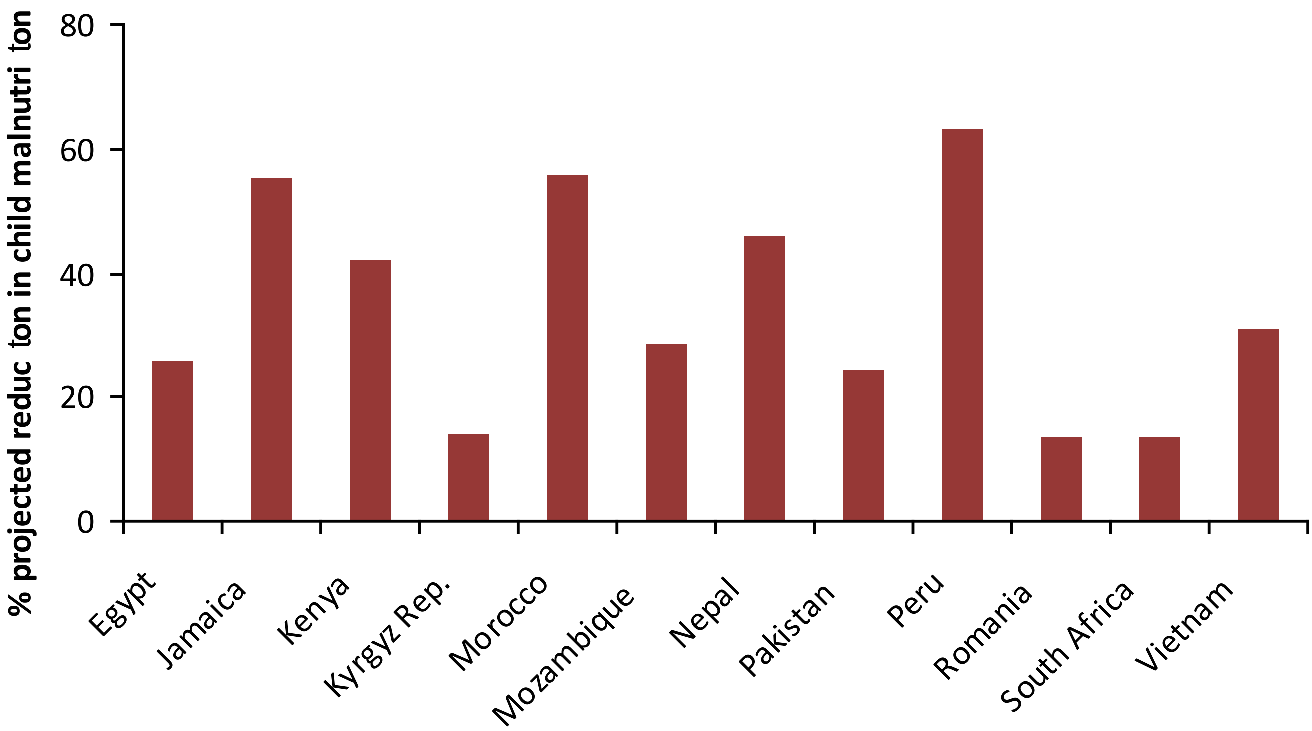
to reducing undernutrition. One reason could be the assumpton that
improved nutriton and that this line of reasoning
economic growth has the potental to contribute to
household or individual income from agricultural g
to purchase not only more food, but also food that
higher incomes could also allow them to consume a
ton. Few studies quantfy these efects satsfactoril
or conficting results on the link between growth an

a number of studies argue that overall economic growth—[illegible]
and per capita income—is weakly associated with [illegible]
Bouis and Haddad 1992). These studies assert that the re
reduced child malnutriton warrants the use of supp
and nutriton directly. Furthermore, some studies h
income and nutriton, economic growth may not neces
economic factors—including changes in relatve food
in savings—may have a negatve impact on nutritonal
et al. 2004).

In contrast, another group of studies has found
and nutritonal status—either directly or indirectly [illegible] 1996 [illegible]
Tifn [illegible] 1998; [illegible] 2005; and [illegible] 2009). For
from rural areas in Maharashtra, India, show a pos
expenditures, with an elastcity of 0.3–0.5 [illegible]
1996)—which is consistent with the long-standing p
income [illegible] (Engel's law).

[illegible] using cross-country data, Haddad et al. (2003) measured th
malnutriton as a result of economic growth over a
countries. The study found that sustained income g
undernutriton through 2015 (Figure 1). [illegible] results project th

Figure 1—Projected reducton in child malnutrit[illegible]
income from 1990s to 2015 (%)



Source: Haddad et al. (2003).

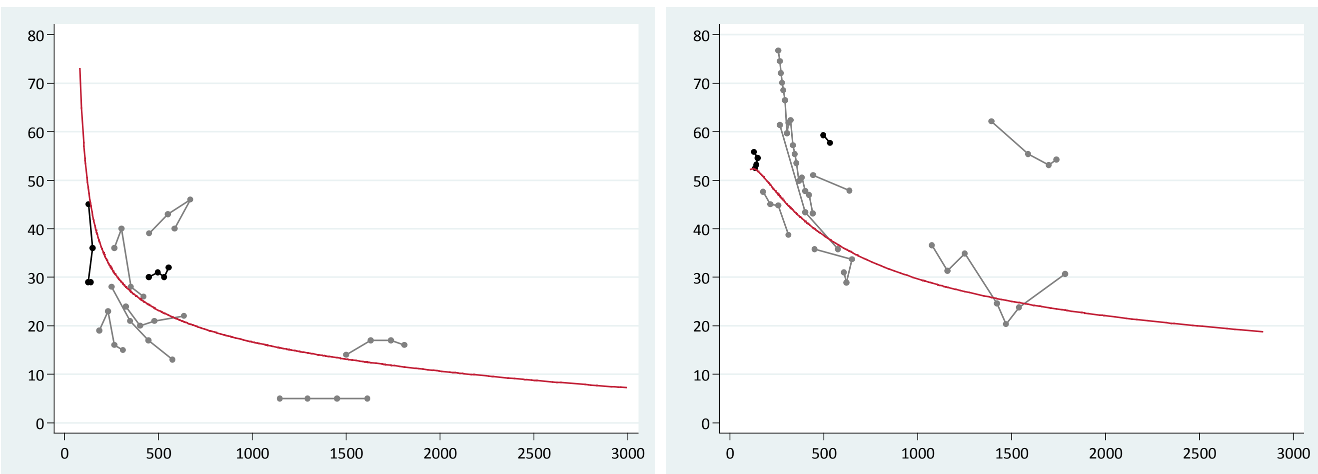
of 2.5 percent between the early 1990s and 2015 re
of (1) 27 percent if community and household infra
to household and community infrastructure ... A cross-country analysis co
similar findings: few of these countries included in
annual per capita income growth greater than 2.5,
not have been enough to meet the Millennium Development Goal (MDG) of halving
Consequently, the authors argue that a more balanc
income growth and cost-effective health and nutrition
nutrition education—are used simultaneously. Similar
growth and direct nutritional interventions are each
among children, alone they are insufficient to meet the targets for halving the pr
children under five years of age (Rossi 2005).

These studies have a number of shortcomings, esp
issues. First, long time-series data on nutrition ar
countries (Smith and Haddad 2000). The indicator used to measur
a large impact on the results of these studies. Fo
initial rapid growth can have a large impact. If nu
underweight, wasting, or stunting—the immediate impa
even different measures of calorie variables, rangi
found to result in different empirical results ([illegible] 1998). [illegible]
use of average calorie deficiency as a measure of g
often based on unreliable and conceptually flawed da
distribution and calorie requirements across differe
of child undernutrition indicators has also been qu
small genetic differences in growth potential between (Klasen 2008)

Second, many past studies have failed to recogni
and nutrition outcomes. Moreover, in this rel-ationsh
tional impact of growth diminishes or disappears af
other interventions and the potential for [illegible] exploitation. for
on the relationship between economic growth and nut
homogenous process across countries; however, recent evidence has sh
country's stage of economic development can signif
tion. For example, ...ecker et al. (2011) use cross-country regre
growth to reduce undernutrition among the general p
economic status (Figure 2).

according to this study, undernutrition levels dec
early stages of a country's growth, [illegible]

Figure 2—Undernutrition-growth trends in select



Source: ...ecker et al. (2011).

economic development ladder the relatonship betwee
with the impact of growth declining when GDP per capita exceeds US$500 (approx
constant US 2000 dollars). The study found a similar pat
growth and child malnutriton is found to be more m
even during the early stages of a country's econom
factors such as health and educaton mater more for

another shortcoming of past growth-nutriton analy
deaton (2001) argue that the low calorie-income el
quality of the diet remains unchanged with income,
The authors fnd that although the intake of ... y e
income, the intake of fat, calcium, ribo ...
by Skoufas et al. (2009) in Mexico examines the ef
consumpton at the household level. Income is found
consumpton of nutrients ... iron, fat, calcium—tha
among the populaton. The relatonship is larger for
decreases at higher percentles, it remains sizable
statstcally signifcant but quite small.

The contnued existence of divergent opinions on
outcomes calls for more empirical research on the
specifcally, the "economic growth" variable needs

3. Do Sectoral Growth Patterns Matter?

3.1 The Agricultural Sector

Past development experiences have shown that the a
many countries and that a successful economic tran
and increased agricultural productvity, especially
for example, Johnston and Mellor 1961). In fact, t
been shown to slow down economic transformaton and
challenges (Tifn and ... 2008; ... 2006; Breisinger and

a number of studies have found that growth origin
poverty than growth in other sectors ...
Janvry and Sadoulet 2009; ... 2008) ...
tural sector promotes overall economic development
and consumpton between agriculture and the rest of
growth from the agricultural sector, not only beca
mately three-quarters of the developing world's po
2007)—but also because the sector typically accoun
employment in many ... however, the ... potental of agr
between regions and with the structural features o
tural incomes, beter infrastructure, and greater u
green Revoluton ... Punjab ... two tmes high
such as Bihar and ... Pradesh (... 1991).

now the queston is to what extent agricultural gr
culture—can be a springboard for nutritonal improv
producton and lower food prices. The conventonal h
a larger impact on improving nutriton levels than
pathways through which agriculture can ... (World
Bank 2007). ... one hand, agricultural growth can have

- Increased household producton leads directly to
- Increased agricultural producton for markets ra
  purchase food and gain access to health and edu

- Lower and less volatile food prices from rising ... food buyers, while also freeing additional house...
- Increased government revenue can be used to fina... structure, and nutrition intervention programs.

On the other hand, its impact can also be negative...

- agricultural growth led by intensified use of mo... cides) and irrigation practices may also have neg...
- Intensification of agriculture may reduce women's...

Empirical evidence on the nutritional impact of ... one of the few s... conducted by ... (2010), who finds that the impact of ec... undernutrition varies across ... agricultural growth, in part... reduction in underweight, but also leads to reduced ... tion of India. Moreover, agricultural growth is pos... at lower levels of calorie consumption), although e... dietary diversity—used as a rough proxy for ... micron... finds that pro-nutrition growth—namely, "transformat... and improvements in education and health outcomes—h... tions in undernutrition than regular economic growth ... and programs to reduce undernutrition ... calorie deficiencies ... (2011) shows that the impact of agricultural growth ... study ... Yemen shows that while agricultural growth can lea... is only 10 percent of its impact on calorie deficie... agricultural growth are needed if the final objectiv...

3.2 Agricultural Subsectors

Within the agricultural sector, individual subsect... development outcomes. Whether growth in a subsecto... linkages with rest of the economy, (2) its initial ... (4) market opportunities ... number of recent studies ... African countries ... the differential impact of various agricultural subs... (Diao et al. 2007; Pa... 2010). These studies simulated the contribution of g... economic and agricultural growth, poverty reduction ... impacts by increasing the growth rate of one subse... constant. ... A recent study ... Africa, ... for example, found that ... household dietary diversity—based on the assumption that dietary dive... content—varied according to ... (2010) ... sources of income ... Specifi... cally, appears to have a relatively strong positive ... salary appears to have a negative effect.

A recent study by Pauw and Thurlow (2010) finds th... poverty reduction, and nutrition outcomes is due to ... growth. More specifically, Tanzania's rapid growth ... ments in poverty and calorie availability ... and dynamic computable general equilibrium model o... agricultural growth did not benefit all farmers equ... grown in specific parts of the country.[1] ... comparison ... of alternative sources of agricultural growth revea... intake is derived from growth led by maize, follow... crops not only are important expenditure items for ...

[1] Various analyses related to the impact of different compo... rium (CGE) models. The advantage of this is the ability to model the imp... such as income, prices, employment, and wages. The weakn... the model using empirical data.

Table 1—Poverty-growth and calorie-growth elasticities, Tanzania (2000–07)

Product	Calorie-growth elasticity	Poverty-growth elasticity
Maize	-1.9	-1.5
Sorghum and millet	-1.5	-1.5
Pulses and oilseeds	-1.8	-1.4
Roots	-1.1	-1.5
horticulture	-1.0	-1.4
Livestock	-0.7	-1.3
export crops	-0.8	-1.4

Source: Pauw and Thurlow (2010).

poor farmers ... In contrast, specific parts of the country by larger-scale farmers. The terms of both poverty reduct intake—can thus be enhanced subsectors with stronger lin regions.

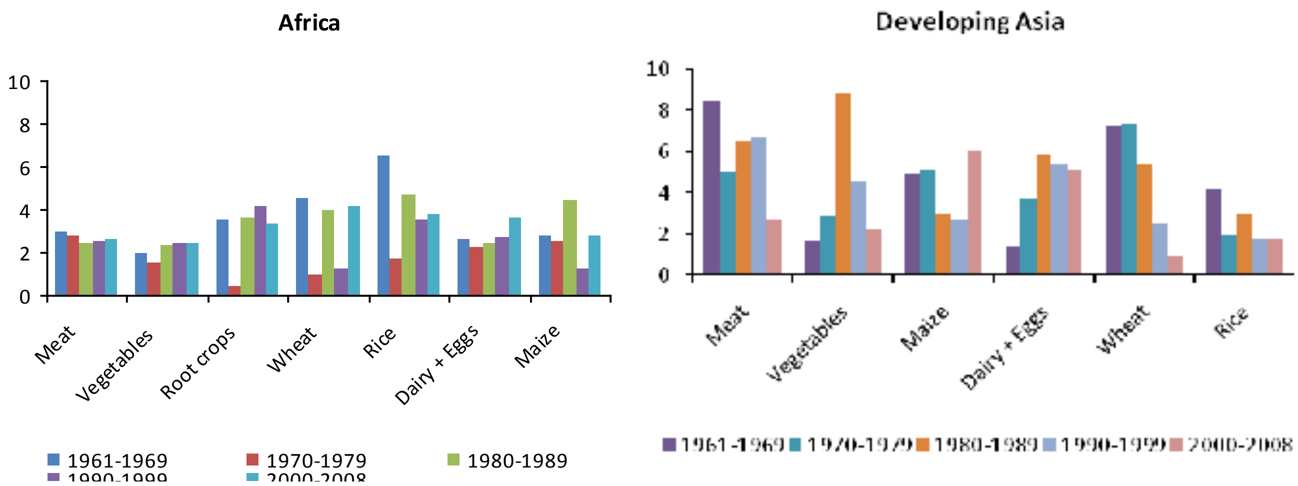
A similar study by Pauw ... (2007) also finds that the contribut to poverty reduction and calo the contribution of any other cultural sector modeled. The and other staple crops are t source for the majority of s

the largest share of the ... incomes and consumption, for example, results from and technologies required to ... growth on calorie consumption varies according to and Rosenzweig 1997). Income increases during the consumption among smallholders, whereas the nutritio food-abundant harvest stage, especially for poore

The differential impact of agricultural subsectors resource and economic conditions within many develo role in decreasing poverty and ... subsectors have different effects on ... although growth in staple crops will be the domina will not be not be sufficient to reduce poverty and necessitating a more balanced agricultural growth s The study thus emphasizes the need for regionally agricultural subsectors to improve nutritional stat growth priorities vary across regions and how the p objectives. The policies and interventions planned a especially be integrated with specific interventions

The results just described may not hold, however intake to include diet quality, micronutrients, or Research on the effects of different growth patterns a range of indicators of nutritional status, includ stunting among children. Indeed, in the past severa

Figure 3—Production growth, 1961–2001 (%)



Source: FAOSTAT database (2011).

dramatcally because of diferent growth rates among
egg, and dairy proasuicaat.folmlichna,veprinodcuretaosnedofinrice, wh
faster than that of meat, dairy, and eggs. In many
will be difcult in the short run and may also invo
programs sharsuecshtPalus can be used to add nutrients to
biofortfcaton will allow consumers to ianpcireoans,e athde
even if their diet paterns remain the same.

4. How Do Conditional Factors Affect the Link between Growth and Nutrition Outcome?

Many factors related to underlying conditons withi
nutritonal outcomes. In other words, given the sam
these factors will result[2] in beter nutriton outcom

4.1 Land Distribution

access to productve assets such as land is associa
oping countries through a number of channels. Just
that land is one of the most valuable productve re
securing a sustainable livelihoagdarwal 2002a; Finang,
de Janvmroyt 2o0n0l2y).do land endowments provide individ
but they also facilitate farm households' access t
ton relatve to the market—especially in areas with
markets. When land distributon is more egalitarian
widely shared.

The positve relatonship between access to land a
has been documented in a number of studies. Prelim
the aboliton of intermediaries and the impositon o
nutritonal outcomes, which ghasshme2a0s0u7r)e.d Sisminilgarwboy,e
nutritonal efects of land distributon in China fou
output or income from that land (Burgess 2001). Th
a greater nutritonal impact than targeted social a
land access provides the benefciaries with a cheap
the main features distnguishing China from other d
similar economic growth—such as India—are China's
distributon of land.

however, the link between land distribuontotnheaondneu
hand, evikdeenyceashfowws that tenants of setlement sche
food consumpton, and nutritonal bsotcartwuesg tehtanalth1e99r6e
incorporaton of farm size into the analysis reveal
incomes but not higher food consumpton nor beter n
less of-farm employment among larger farms. The au
income and lower nutritonal outcomes among larger
measure economic as well as social and nutritonal
far behind in another. Furthermore, before access
reforms need to include a comprehensive package of
resources, such as credit, capgiutaarld,iatne c2h0n0o3l)o.gy, an

4.2 Women's Status

gender inequality in nutritonal satsaitausshoawsribgeeensweic
alarmingl atsreenndlsy9 9(6n;d Chadudahucerri, 2R0a0m8;ohan, and Murray
to woman's roles include weak land rights; lower l

[2] In an econometric sense, these variables (or factors)
interactve impact with the growth variable.

services and technologies. Women's access to land,
household and hence the consumpton of cert agianr wgaolod
2004).

nonetheless, many past growth-nutriton analyses h
variables despite ample evidence that men and wome
consumap tnoumm.ber of studies have found that children'
control over household resources. For example, cro
that women's higher status—as measured by women's
equality between women and men—is a signifcant and
The strength of the relatonship between women's st
the largest asimpacttheinreSgouiotn would have 13.4 millio
women had equal status. asTihaen mautlhnuotrsriatsonerrtaatrhsat a rSeo
those in other regions not onlays ibaec,abuuste awlosmoe rb'esc asuts
women's status on child nutriton is higher in the

Furthermore, households in which women have more
child nutriton—improving diet quantty haonddd iqnuoat liantyd—
haddad 1995; Rogers 1996; Thomas 1997). Fo-rh eeaxdaemdpl
households ingaRmwbainad ac oannsdu mTehde 377 and 322 more calo
respectvely, [illegible] (Pieters 1993)n. Braz
that the efect of women's income on nutriton is fo
Studies in Cetôhtieopdi'aI vfooiurned atnhdat women's income and
have a positve efect on food expenditures, whereas
and cigqaurisrtuemsbi(ng and Maluccio 2000). In fact, low-
beter nutriton than higher [illegible]
agricultural growth that benefts women can lead to
higher incomes among women, it can also have a neg
allocaton paterns, reducing women's tme for childc

4.3 Rural Infrastructure

a large body of evidence has closely linked investr
electricity—with growth in agricultural productvit
to beter health and nutriton through a variety of
by raising agricultural productvity, lowering prod
partcipaton of the poor in the development process
consumpton of food among [illegible]
the poverty reducton impact of infrastructure with
between diferent public investments and nutri-ton i
ton is not surprising given the large body of evid
growth in agricultural productvity and poverty red
for instance, is important for the livelihoods of
development in rural areas, both by raising the co
by delaying the sale of harvested crops. In China
have among the largest positve impacts on poverty
win-win developmhaezn isltr, aatnedg Tzhhaonrg (Fe2n0g0 02;0 0F4a)n., Recen
from India shows that the impact of income growth
is incorporated, implying that a fair share of wha
nutriton is actually dhuea ttoe yi netsatlm.e n2t0s1 0i)n. infrast

Infrastructure also improves access to more and
of infrastructure—including safe drinking water, h
as India, Peru, and Sudan has been shown to reduce
Merchant et al. 2003; Checkley et al. 2004). Simil
is a statstcally signifcant determinant of child u
accountng for 20 percent of the diference in malnu
et alh.o w2e0v0e3r),. the provision of infrastruconturtee ddooeess
hand, improved infrastructure in the form of incre

is especially important for child nutritional statu
(Borooah 2005; Bose 2007). On the other hand, access to electrici
a larger and more significant effect on child weight
distribution (Kumar, Gunewardena 2006). Similarly, the
structure in Peru has been shown to have an especi
(height-for-age) in poor urban areas, whereas the
insignificant. These studies thus emphasize the imp
(such as improved infrastructure) with direct nutr
that target at-risk children.

4.4 Health Status

health and nutritional status are directly linked; undernutrition is
major causes of immune deficiency, and illness impa
body's ability to absorb nutrients, which in turn
2003). Individuals with HIV/AIDS, for example, have higher nutritiona
general population—10–30 percent higher among adult
loss of appetite associated with the illness means
requirements are higher.

health status can have a significant impact on nut
part in productive activities that generate food or i
to undernutrition through a number of pathways (2004), including the (Fo

- decreased work productivity resulting from ill or
- increased medical and health care costs for hou sick urban dwellers and migrant laborers;
- increased household dependency ratios through lo dead relatives into households; and
- loss of local intergenerational knowledge and sk

Working through these pathways, sickness and dea
land, yields, and agricultural employment (2004; Gillespie and Kadiyala 2005). Results from
show that agricultural households that suffer HIV/AIDS) from
experience a significant reduction in food production
these households are dependent on own-farm production/consumption
and the loss of labor resulting from poor health ca
diversity, with affected households switching to le
lower in nutritional value (2004; Barnett and Rugalema 2001). Important
the impact of health on the link between agricultu
of factors such as the length of an illness, the d
position in the household (Gillespie and Kadiyala 2005).

5. Strategies and Investments for Pro-Nutrition Growth

given the dynamic relationship between agricultural
can be addressed in a number of ways. The question
resources. This section pays special attention to the
and set priorities for public spending to reflect th

5.1 Growth Strategy

Recently, changing attitudes among both researchers
strategies" have led to increased demand for resea
conditions of development and undernutrition alternative economic
is a key component of as shown in the previous section
growth—nonagricultural and agricultural—and undern

is needed to support evidence-based policymaking a
their impact on nutriton, the diferental impacts o
factors on growth-nutriton links need to be taken

So far, nutrition has not been widely used as a
strategic view of national agricultural and rural development programs (PRSPs) that the food and nutrition
istent. This is often the case because food and n
as ministries of agriculture, social affairs, and
nutrition within the main agricultural strategy m
nature of nutrition often has the result that nut
orphaned" (2009).

growth strategies should be designed with a nutr
and subsectoral practices and public investments that
could contribute to increasing demand for and acc
nutrition-sensitive value chains can be built thr
and awareness campaigns that increase demand for
nutritional value of foods along the value chain.
nutrition risks associated with agriculture, such
well as occupational injuries and health hazards.
crops that are enhanced with bioavailable nutrien
specifically, biofortification has the potential
cially among undernourished populations who are l
marketed fortified foods and supplements. Plant breeding programs
Challenge Program, for example, breeds more nutri
by poor people in developing countries. Nutrition will no
growth strategies that incorporate biofortificati
of the nutritional and economic impact of biofort
tions. Setting priorities and sequencing these in
should depend on country-specific conditions such
capacity. In order to maximize the nutrition impa
placed on the role played by conditional factors.

5.2 Investment Strategy and Fiscal Policies

Public investments in rural infrastructure and agr
impacts on poverty reducton and economic growth in
There is no empirical evidence, however, showing h
nutriton interventon and nutriton educaton eforts
also confront the challenge of allocatng such reso
most developing countries are scarce and the oppor
resources more efciently, taking into account posi
the efects of public investments should be expande
how to prioritze public spending according to nutr
of a pro-nutriton growth strategy can also be redu
implementaton.

Fiscal policies, like taxes on unhealthy foods a
maximize positve and minimize negatve spillover ef
subsidies on diets in developed countries have bee
2004; Jais, Brecht et al., 2008; Salois and Tifn 2010). Tax
be useful in generatng government revenue, but the
by interventons that discourage the consumpton of
nutrient-rich foods such as fruits and vegetables.
policies to support consumpton of more nutritous f

6. Conclusion

This paper has sought to give an overview of the n
infuence of conditonal factors on the nutriton-gro
ship between subsector agricultural growth and nut
important step to ensure pro-nutriton growth. The
set priorites and sequence interventons in order b
new paradigm for agricultural development is neede
producton and reduced poverty, but also to improve
following:

- economic growth maters in many developing count
and tme and there is a nonlinear and dynamic re
economic growth has a bigger impact on malnutri
economy is stll relatvely small.

- diferent sectoral and subsectoral growth patern
It does mater whether growth comes from the agr
agricultural sector, it also maters whether gro

- Conditonal factors, such as land distributon, w
have an impact on the growth-nutriton linkages.
access to land and nutriton as well as gender e

- growth alone is not sufcient to address malnutr
targeted nutriton programs) are needed. Interve
health and nutriton are partcularly important.

- growth strategies and investment policies need
likely trade-ofs between implementng pro-nutrit
as poverty reducton, and using other instrument

- More research is needed on the impacts of difer
nutriton, and how these impacts vary across dif
research needs to be based on more comprehensiv
across diferent segments of the populaton.

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This paper has been peer reviewed and may be further r
of the author(s) and are not necessarily endorsed by c
organizatons. IFPRI gratefully acknowledges the suppor

- asian development bank
- Bill & Melinda gates foundation
- Canadian International development agency
- deutsche gesellschaft für Internationale zusammenarbeit (giz) gmbh
- IFad
- Irish aid
- PepsiCo
- swedish international development cooperation agency (sida)
- The World Bank

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