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UNDERSTANDING AND REDUCING CHILD MALNUTRITION IN MALI: Interim Research Findings for the Project on Linkages between Child Nutrition and Agricultural Growth (LICNAG)



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By

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BACKGROUND: The study of the Linkages between Child Nutrition and Agricultural Growth (LICNAG) seeks to understand better the positive and negative repercussions that agricultural-led growth has on children's health and nutritional status.

The project's primary goal is to recommend means of strengthening positive linkages between agricultural development and other factors that influence child health and nutritional status. To accomplish this, we conducted a year-long study (May 2001 - April 2002) of 750 production/consumption units (PCUs)¹ located in three different agricultural systems—irrigated rice, rain-fed cotton, and traditional coarse grains.

The irrigated rice area of the *Office du Niger* in the Ségou Region, which is characterized by relatively low climatic risk and moderate price risk, represents a zone of strong agricultural growth (during the 1990s aggregate rice production grew from approximately 100 to 300 thousand tons while yields grew at an annual rate of about 8%).

The rain-fed cotton zone in the Sikasso Region, which faces greater climatic risk but less price risk than the irrigated rice areas,² represents a zone of intermediate agricultural growth (from 1992 through 1997 production increased about 18% and yields declined by about 2% annually).

The less market-oriented millet/sorghum production system in the Mopti Region, which faces high climate and price risks, shows no consistent pattern of recent growth in either yields or production, both of which exhibit high inter-annual variability.

OBJECTIVES AND METHODS: This synthesis is the first in a series of policy bulletins presenting findings from the study. It synthesizes the results of preliminary analysis reported in more detail elsewhere (Tefft and Kelly 2002). The objectives are to (1) disseminate the principal empirical findings from analysis of the first six months of survey data, (2) inform ongoing discussions on policies and programs to improve nutritional outcomes in Mali, and (3) elicit suggestions from policy makers and development practitioners for future analysis of the LICNAG data.

¹ Although we use PCU and household interchangeably in this report, a PCU may represent a single household (nuclear family) or several households (extended family) living together under the direction of a single PCU head.

² Price variability is moderated to some extent by the CMDT, which does not fully adjust farm-gate prices in response to annual fluctuations in world prices.



The analysis describes the situation concerning nutrition, morbidity, and mortality of children less than four years old. The focus is on cross-sectional comparisons across age and gender groups, different types of production zones and some household characteristics. Subsequent analysis will include more detailed reporting on household income, consumption and agricultural production, and also discuss child feeding, care giving and hygienic practices.

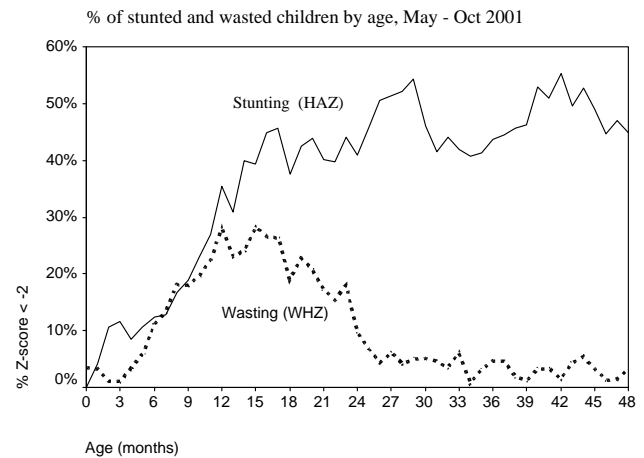
KEY FINDINGS: High prevalence of stunting and wasting by 18 months: Across the entire sample, preliminary results show that 36% of children less than four years of age are stunted and 12% suffer from wasting (Z-scores³ < -2.00). These figures are considerably higher than the 2.3% prevalence expected in a population of well-nourished children. Results also show a higher prevalence of stunting among boys (39%) than girls (33%), and high prevalence of severe stunting (15%) and wasting (2%), indicated by Z scores less than -3. Although these patterns of higher rates of stunting, lower rates of wasting, and gender differences are common throughout Sub-Saharan Africa (Martorell and Habicht 1986), the prevalence of stunting in Mali is among the highest in the Sahel.

Analysis of anthropometric data by age reveals that wasting and stunting set in early (Figure 1). In the first five months of life, 5% of sample children are wasted and 10% are already stunted. The prevalence of both stunting and wasting increases rapidly through the first 18 months, by which time 40% are stunted and 25% are wasted (Figure 1). Inappropriate infant feeding practices appear to be partially responsible for these results as the 2002 Demographic Health Survey (DHS III) reports that many parents are not following two very important UNICEF and Ministry of Health recommendations:

- All children should be exclusively breast fed for the first 4 to 6 months of life (i.e., no water, juice, or other foods), yet only 25% of mothers interviewed for the DHS III survey followed this advice through the 5th month;
- By 6 months all children should be receiving both solid foods and liquids regularly to supplement breast milk, yet only 26% of Malian children receive supplements by their 6th month and only 59% receive regular supplements by one year of age (Ministry of Health 2002).

³ A Z-score is the number of normalized standard deviation (SD) units that the child's measurement deviates from the mean of the reference population of healthy, well-nourished children.

Figure 1: Prevalence of malnutrition in Mali



At 18 months, wasting rates for the sample children begin to decline, dropping to 4% for children from 3-4 years old, while the prevalence of stunting increases to 49% by age 4. The growing prevalence of stunting accompanied by reduced levels of wasting suggests that children never fully recover from early growth deficits. This failure to recover underscores the importance of targeting caregivers of very young children with interventions to improve breast-feeding and complementary feeding practices.

Less stunting in the rice zone, more wasting for coarse grain zones: There is a lower prevalence of stunting (statistically significant at <.05) among sample children in the irrigated rice sub-regions of Macina and Niono (19 to 25%) relative to other sub regions studied (35 to 48%). For the entire rice zone, only 23% of sample children have HAZ scores less than -2.00; this is substantially lower than Segou's region-wide estimate of 41% reported by DHS III. The disaggregated nature of the LICNAG analysis lends itself to the identification of sub-zones such as the rice production areas with better child health and nutrition, permitting us to test a variety of hypotheses regarding the determinants of these differences.

Many factors related to health, care and feeding practices, and hygiene that affect children's nutritional status vary across households, regardless of location. However, there are socioeconomic differences among the agricultural zones that may help explain the lower prevalence of stunting in the rice zone. First, households with access to irrigated land can grow two profitable crops a year (usually rice and



vegetables) in a relatively low-risk production environment. Second, greater access to water, fertilizer inputs, and processing technology has fostered high productivity and income growth in the zone since the mid-1990s. Third, the production system provides numerous opportunities for women to increase their personal income (e.g., onion production, rice transplanting). Fourth, household structure (nuclear rather than extended families) appears to increase the ability of parents' of young children to control productive resources and income, thereby increasing their ability to care for their children in a timely manner.⁴

The higher prevalence of wasting in the coarse grain producing sub-regions of Bandiagara and Koro in the Mopti region (16%) compared to levels in the rice and cotton areas (9-11%) may indicate relatively greater short-term difficulty in satisfying children's food needs, particularly during the hungry season when food stocks run low and the new harvest is not yet available. These preliminary results fall in line with the results of a 2001 Public Attitude Survey, in which 62% of all respondents in the Mopti Region, where Bandiagara and Koro are located, mentioned hunger as a personal problem, compared to 39% for the rest of the country (Bratton, Coulibaly, and Machado 2001). Recent analyses of per capita food production by administrative region also support the conclusion that the availability and access to food is a bigger problem in Mopti than in Segou and Sikasso (Tefft et al. 2000).

Analysis by age shows that the prevalence of stunted children increases rapidly in the cotton zone, attaining 50% for children 12-17 months, compared to 32% for the coarse grain zone. As explained in footnote 4, the surprisingly greater prevalence of stunted children in the higher income and food surplus cotton zone (Sikasso) relative to the poorer, food-deficit Mopti Region may be partly due to the large share of income controlled by the PCU head in cotton households. This hypothesis will be tested in subsequent analysis.

Better nutrition for children of educated parents: Despite an extremely small sample of parents with some formal schooling (4% of mothers and 11% of fathers), results show that children of parents who have attended school (one to six years of formal education) have lower rates of stunting (34%

and 31% respectively for mothers and fathers with some formal education versus 39% and 41% for parents with no schooling). Since formal schooling is often associated with higher incomes, future analysis will attempt to separate the role that income and education play in shaping health and nutrition outcomes.

Higher income associated with better nutrition: One LICNAG study objective is to examine how children's nutritional status varies with the level of income for the entire household as well as for individual members of the household, particularly mothers. The collection of expenditure data disaggregated by individual household members is a major contribution of the study. Studies of child health in developing countries often use data on asset ownership (e.g., radios and bicycles) as a proxy for income data, which is much more difficult to collect.

Previous studies have found that higher levels of household assets play a statistically significant but small role in promoting positive health and nutritional outcomes (Behrman and Deolalikar 1988). Similarly, preliminary LICNAG results show that higher expenditure levels (a better proxy for income than assets) exhibit a statistically significant but small correlation with better health and nutrition outcomes. Average monthly household purchases per capita⁵ are lowest in the coarse grain production areas of Bandiagara and Koro, where the prevalence of stunting and wasting is high, and highest in the irrigated rice zones of Niono and Macina, where children's nutritional status is better. Average household expenditure in Niono is two to five times higher than the levels in the cotton and coarse grain zones.

More importantly, the LICNAG study examines the impact of expenditures by different individuals within the household, including the head of the household, the mother and the father of the child. Analysis disaggregated by gender and household status shows that:

- Expenditures by men are more than double that of women;
- Expenditures by all men are much higher than those by fathers of children under 4 years; and
- Expenditures by fathers and mothers of infants under 4 years are approximately the same within each zone.

⁴ In large extended families, parents of young children rarely have decision making control over household assets and income, but must ask the household head for assistance when their child is ill or needs more food.

⁵ This estimate represents the average value of purchased goods and services (not including home-produced or purchased cereals and livestock).

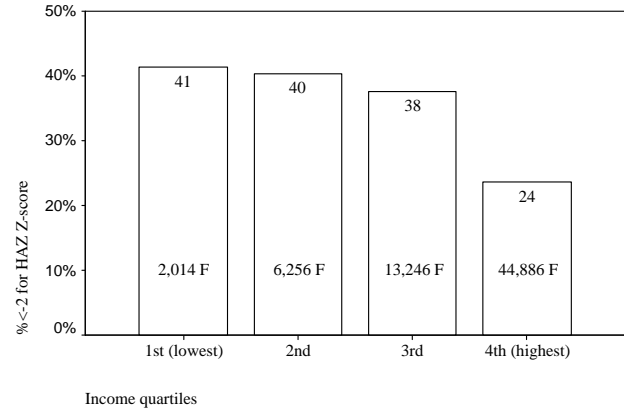


Most striking is the magnitude of the difference across sub-regions between overall male expenditures and fathers' spending. This occurs because many fathers in the sample are not the head of the large extended family but live in "dependent" units within the larger family that is headed by a father, uncle, or older brother. In the cotton zones, where cotton income goes to the head of the extended family, male expenditure ranges from 4.5 to 6 times greater than fathers' expenditure. These differences are in stark contrast to the situation in the rice production zones (Niono and especially Macina) and the coarse grain zones (Bandiagara and Koro), where the expenditure for all men is only 1.4 to 2.5 times greater than that by fathers. In Ségou, where there are smaller production units that more closely resemble nuclear families, fathers of young children appear to have greater access to and control of productive assets (primarily land) and the returns to their use.

Average monthly expenditures of women in the rice-growing zone are two to four times that of women in other sub-regions, while those in the Bandiagara sub-region of the coarse grain zone are more than double those in the Koro sub-region of the same zone. Although in-depth analysis of expenditure and agricultural income data will provide additional information leading to a better understanding of this question, income earned in horticultural production in the Macina, Niono and Bandiagara sub-regions appears to be a primary factor differentiating higher expenditure levels for women in these zones.

When matched with anthropometric data, the results show that both households' and mothers' incomes are positively and significantly correlated with higher Z-scores indicating improved nutrition. Mothers' income shows a stronger association (larger correlation coefficient) than household income. The prevalence of stunting is significantly lower for children of mothers in the highest income quartile (24%) relative to the levels for the three lower income quartiles (38-40%) (Figure 2). The very large change in both incomes and prevalence of malnutrition for women in the fourth income quartile suggests that a mother's income may need to reach a certain threshold level before it can have a major impact on reducing malnutrition. It is also possible that qualitative differences in these households (e.g., behavior and attitudes correlated with income) might explain the differences.

Figure 2: Prevalence of stunting by mothers' income quartiles (May - Oct. 2001)



Prevalence and treatment of childhood illness: Preliminary analysis of morbidity data⁶ reveals that fever/malaria and diarrhea are the two most common illnesses reported by caregivers (48% and 21% respectively, of all episodes of illness). Illness is most prevalent for children between the ages of 6 and 17 months. Mothers diagnosed 67% of all illnesses, while health professionals and family or friends were consulted in 15% and 11% of the cases. Fathers and household heads (who are all males) paid for 64% of treatments, while mothers paid for 34%. No treatment was sought in 19% of all episodes. For cases treated, modern medication was purchased in approximately 75% of the cases, while traditional medicines were used for the others.

Average expenditure per treatment, regardless of type, falls between 900 and 1000 FCFA, suggesting that the choice of traditional versus modern treatment may not be driven by cost. Household heads, fathers and mothers spent on average 1370, 1028, and 755 CFA francs per treatment. Fathers and household heads spent 18 to 31% more on modern than traditional treatments; mothers spent 78% more on traditional than on modern treatments, even though 75% of the individual treatments for which mothers paid were modern ones. This suggests that mothers may be purchasing inexpensive modern medicines such as aspirin and chloroquin while fathers and PCU heads may be paying for more expensive modern treatments involving antibiotics or chloroquin injections for malaria. Mothers may also cover initial treatments, with fathers or PCU heads intervening only

⁶ The particular categorizations of illnesses, and types of treatments reflect the perceptions of the caregivers rather than the opinion of medically trained personnel.



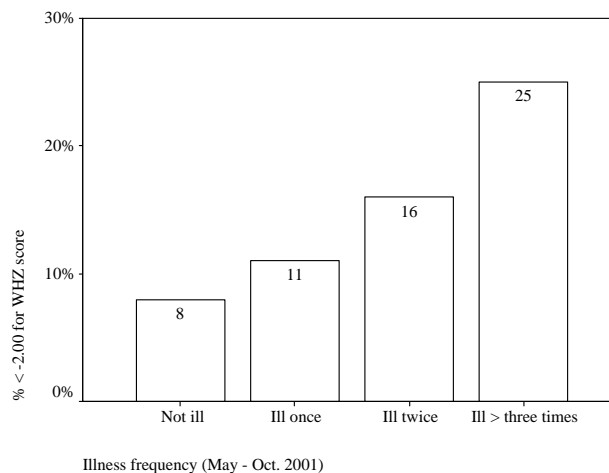
when illness persists and additional resources are required for a consultation at the health center.

The analysis of expenditure data, for which a child less than 4 years old was the intended beneficiary, show that total parental expenditures are approximately 100% greater in the zones where there is the strongest evidence of agricultural productivity and income growth (Koutiala and Niono). This suggests that increased household income may result in increased expenditure on children. Fathers' average expenditures on health are higher than their non-health expenditures while mothers' non-health expenditures on children are over double the amount spent on health. These results suggest that fathers accept responsibility for major curative expenditures but not for day-to-day child maintenance. Consistent with the income data presented above, mothers in the Niono sub-region have the highest level of expenditures on health and non-health items for their children; those in the Kolondieba sub-region spend the least amount on their children. These patterns may be a reflection of lower personal income for women in Kolondieba, resulting in a greater need for men to cover curative costs.

Child morbidity is associated with low weight gain and high mortality: Analysis of data on children's daily weight gain confirms that growth is hindered by episodes of illness. Infants gain on average 1.5 grams per day following episodes of illness (down to only 0.13 grams per day following fever or malaria), a rate significantly lower than pediatrician recommended levels. Results show that nutritional status is significantly worse for children plagued by frequent episodes of illness (Figure 3). For example, the prevalence of wasting is 25% for children with three or more episodes of illness over a six-month period, while it is only 8% for those who were not ill.

The most sobering result to date is that from the time the initial household census was completed in May 2001 through October 2001, 61 out of approximately 2100 sample children have died; 70% of those who died were less than two years old; 61% were girls. Prior to their deaths, 43% of the children were stunted (17% severely with HAZ < -3.00) and 38% were wasted (15% severely with WHZ < -3.00). The high prevalence of wasting (38% versus 11% for overall sample) indicates that children's weight had dropped substantially in the period preceding their death. These preliminary results indicate that when the combination of inadequate food intake and reoccurring illness during the

Figure 3: Prevalence of wasting in ill children



first two years severely hinders weight gain and growth, infant mortality is likely to be high.

LOOKING FORWARD: IMPLICATIONS OF PRELIMINARY FINDINGS: Need to improve nutrition and health services for children under two years old: Preliminary findings point to the rapid onset of wasting and stunting in children between the ages of 6 and 11 months, with the prevalence rapidly increasing through the 18th month. Given the low rate of compliance with recommended feeding practices for infants documented by DHS III, it appears that health and nutrition interventions focused on improving breast-feeding and supplementary feeding practices during a child's first year of life could contribute substantially to reductions in stunting and wasting among children of all ages.

The high prevalence of stunting and wasting reported in this research and DHS studies indicates that substantial difficulties remain in the effective and sustainable delivery of nutrition and health services for children (e.g., growth monitoring, nutrition education, malaria prevention, and diarrhea treatment) at the health center and village levels as outlined in the Ministry of Health's minimum package of health services.

A more comprehensive multi-sector approach is needed: Interim findings also suggest that nutrition-related interventions included in the Ministry of Health's minimum package of activities may, by themselves, be insufficient to deal with the entire array of factors contributing to



malnutrition. Most prominent of these factors is the widespread poverty and hunger throughout Mali that affect the ability of households and caregivers to adequately feed and care for their children. Parents may find it hard to provide supplementary foods when they do not have the purchasing power to buy nutritionally rich and diverse food products. The high prevalence of illness among children in the sample also suggests that hygiene and access to potable water and mosquito nets, in addition to access and use of health services, must be systematically addressed.

The presence of these problems point to the need for a more comprehensive, coordinated, multi-sector approach in which other line ministries are committed to and involved in the efforts to systematically address the entire range of factors influencing children's nutritional status.

Different Approaches for Different Zones: One of the most important insights emerging from the analysis of children's health and nutritional status in three different agricultural systems is that the priority actions needed to improve health and nutrition are likely to differ by cropping system.

Irrigated rice zones: Initial results show that in the rice zones (1) per capita income for the parents of children less than four years old is significantly higher, and (2) rates of wasting and stunting are significantly lower than in the other zones.

These findings validate research conducted in the *Office du Niger* irrigated rice system following the 1994 devaluation of the CFA franc which found that (1) aggregate household incomes for most producers increased in real terms following the devaluation, and (2) women's access to income generating activities (e.g., rice transplanting and onion production) improved (Mariko, Chohin-Kuper, and Kelly 2001). These positive results highlight several factors that have reduced rice farmers' exposure to climatic and price risk, allowing them to raise their productivity and incomes: competitive, profitable markets with remunerative prices; regular access to affordable, quality inputs (water, credit, equipment, fertilizer and knowledge); and an evolving mix of effective policies, well-structured institutions, and appropriate technology.

While the preliminary findings indicate a lower prevalence of stunting and wasting in the rice zone, results also show that children in a small portion of poorer households in the irrigated zone are severely malnourished. This disparity

raises many questions regarding access to and control of land, water, and productivity enhancing inputs. While we cannot draw any conclusions from the analysis at this point, policy makers may want to keep in mind the importance of maintaining safety nets for households that are not realizing the benefits of recent agricultural productivity growth in the zone.

Cotton production systems: The majority of households in the Koutiala and Kolondieba sub-regions depend on the cotton sector for credit, fertilizer, and equipment that are used for the production of cotton and coarse grains. The guaranteed market for seed cotton also provides a relatively secure source of income that is used by household heads to cover production costs, pay taxes, maintain PCU housing, and finance social ceremonies. In this context, cotton is the cornerstone of the farming system in these zones. Finding more effective ways to manage the cotton sector will help preserve the sector's competitiveness and its positive contribution to both household and regional food security.

Preliminary results from this study suggest that PCU heads control a large share of agricultural income, making it difficult for parents of young children (who are seldom PCU heads) to attain a level of financial independence permitting them to adequately provide for the health and nutritional needs of their children. Finding ways to reduce the current concentration of agricultural income or convince PCU heads to redirect expenditures to child health and nutrition (i.e., through educational programs) might contribute to improved growth and development of young children. One avenue for improving access to agricultural incomes might be through diversification of cropping alternatives. The 2001 regional development plan for the Koutiala sub-region reports that there is a high potential but very low current investment in agricultural lowlands (*bas-fonds*) that are used primarily by female farmers for rice production (Deyoko 2000)⁷. Diversification could also help the non- and partially-equipped farmers for whom cotton production is not very profitable (Kébé, Diakité, and Diawara 1998).

Another way of reducing the concentration of agricultural income would be to introduce a more effective rural taxation system capable of taxing PCU heads to increase investments in rural health and education.

⁷ Previous research has found lowland rice production to be very profitable (Dimithè, Staatz, and Kergna 1998).



Coarse grain zones: In Mopti's coarse grain-producing sub-regions of Bandiagara and Koro, the higher prevalence of wasting through the 3rd and 4th year points to a problem of availability and access to food. Lower per capita food production together with the relatively high percentage of residents in the Mopti region who mentioned hunger as a personal problem leads one to conclude that adults as well as children are not getting enough to eat. Although onion production may be keeping incomes higher and malnutrition lower in Bandiagara compared to Koro, child malnutrition rates are still very high in both sub-regions.

Increasing access to food and income will depend on more systematic efforts to reduce price and climatic risk through investment in appropriate water management and transport infrastructure, and the development of other commodity subsectors (e.g., livestock, and onions). Even in the best case scenario, households in these sub-regions will probably still depend heavily on off-farm income to meet their food needs, particularly remittances from young women working as domestic help in Mali's urban centers and from both men and women working as laborers in the *Office du Niger* irrigated rice zone. As Mali moves forward in its efforts to expand irrigated perimeters in the *Office du Niger*, it may be useful from a food security standpoint to consider how the positive spillover effects from the irrigated rice sector can contribute to improved food security of households in zones such as Bandiagara and Koro.

Strengthening the Income-Nutrition Link: Preliminary analysis suggests that agricultural productivity growth that generates higher household incomes is a necessary condition for improved child health and nutrition in rural Mali. The different experiences of the irrigated rice and cotton zones further suggest that agricultural productivity growth is not a sufficient condition: the manner in which growth occurs is also important. Production schemes that fail to offer productive and remunerative opportunities to all adult household members may reinforce economic and social inequalities within the household and offset the potentially positive impacts of income growth on child health and nutrition.

Ongoing KAP surveys and focus group discussions will help reveal some of the key child care and feeding practices that need to be addressed, as well as men's and women's perceptions of how to improve child health and nutrition. They will also help identify constraints to developing sustainable ways to increase mothers' access to and control

of resources that enable them to effectively make and implement health care decisions.

In the aggregate, broad-based income growth that increases the effective demand for health care services is critical to the financial viability of community health centers. To the extent that the systematic delivery of nutrition and health services included in community health centers' minimum package of health activities cannot be financed by the existing cost-recovery based system, higher agricultural incomes channeled through a variety of mechanisms (e.g., monies from village associations or commune fiscal revenues) could serve as another source of funding. Income from these sources could finance salaries for health personnel (e.g., village-based agents), increase the frequency of outreach activities, and expand the package of services that health center personnel offer – both at the center and during outreach – thereby expanding in a sustainable way the actions needed to monitor children's growth and health.

In the rice and cotton zones, where agricultural productivity growth is relatively strong, such taxation is feasible. However, it will be necessary to ensure continued productivity growth which will require attention to the environmental and economic sustainability of the existing production systems. Initial results indicate that the economic base necessary for producing incomes that can be funneled to productive reinvestment in the health sector does not yet exist in the coarse-grain production system of the Mopti region. In this region, incomes will not rise and children's health and nutrition will be unlikely to improve until effective means of stimulating agricultural productivity growth are found.

To researcher, policy maker, and practitioner alike, the magnitude and complexity of malnutrition can be overwhelming. It is easy to get bogged down in assessing the importance of the variety of different family and individual circumstances affecting children's health and nutrition. The challenge lies in determining which strands of the complex web of factors affect the largest number of children and families constitute the biggest priority and are amenable to improvement through direct and indirect interventions. There is no magic bullet, yet none of the solutions will be sustainable without ongoing rural economic growth. But growth is not enough. It also needs to be tapped effectively and reinvested in the health and education facilities needed in rural areas to have a long-term impact on child nutritional status. Thus, understanding the linkages



between rural agricultural-based economic growth and child nutritional status is critical for the future of Mali's children.

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