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Review

Review: Time Use as an Explanation for the Agri-Nutrition Disconnect: Evidence from Rural Areas in Low and Middle-Income Countries

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ARTICLE INFO

Keywords:

Time use
Agriculture
Nutrition
Gender
LMICs
Food consumption

ABSTRACT

Time is a vital input into nutritional outcomes, as it is necessary for the production, procurement and preparation of food, child feeding and childcare. Thus, agricultural interventions may fail to improve nutritional outcomes if they do not take account of time constraints, particularly of rural women who spend a considerable portion of their time in agriculture. Given the potential trade-offs pertaining to time in productive vs. reproductive activities and its implications for maternal and child nutrition, the goal of this review is to systematically map and assess the available evidence, both qualitative and quantitative studies, agriculture-time use-nutrition pathway.

Through an analysis of 89 studies, identified through a systematic search, on rural areas of low and middle-income countries, we observe three findings. First, women play a key role in agriculture, as reflected in their time commitments. Second, evidence from a very limited set of studies suggests that agricultural interventions tend to increase time commitments in agriculture of the household members for whom impact is measured. Third, while changing time use tends to change nutritional outcomes, it does so in a range of complex ways and there is no agreement on the impact. Nutritional impacts are varied because households and household members respond to increased time burden and workload in different ways.

1. Introduction

The causes and consequences of maternal and child undernutrition cut across sectors. There is now a firm recognition of the need for wider development policies to be more effective in tackling the underlying determinants of undernutrition (Bhutta et al., 2013). Agriculture has been recognised as a key sector to leverage for improved nutrition outcomes. However, several systematic reviews to date have failed to find clear evidence that agricultural interventions are associated across the board with nutritional improvement (Webb and Kennedy, 2014).

The current evidence-base on the impact of agricultural interventions on nutrition outcomes is weak due to the absence of sufficient good-quality research and evaluation (Girard et al., 2012; Ruel and Alderman, 2013; Webb and Kennedy, 2014). In particular, Webb and Kennedy (2014) argue that there is a need for more research on the pathways to impact, because many of the existing studies have focused on determining the size and direction of impacts, rather than the

channels by which impact occurs. In addition, many studies and reviews identify women's role as key in leveraging agriculture interventions to accelerate reductions in undernutrition. Ruel and Alderman (2013) argue that all researchers in this field agree that women are central mediators of the pathway from agriculture to nutritional outcomes. However, they also note that few studies measure the impact of agricultural interventions on women's time, knowledge, resources, or nutritional status.

Our review investigates the gender dimensions of changing time use in agriculture, and the subsequent impact on nutritional outcomes due to the time needed for food production, purchase, preparation, child feeding and child-care. Specifically, we attempt to disentangle two pathways: that connecting agricultural practices and interventions and time use; and that linking time use with nutrition, through a rigorous and comprehensive systematic review methodology. The review is aimed at addressing the question on *how* agriculture can produce nutritional impacts via time use. We analyse quantitative, qualitative and

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<https://doi.org/10.1016/j.foodpol.2017.12.011>

Received 30 January 2016; Received in revised form 18 December 2017; Accepted 30 December 2017

Available online 22 February 2018

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mixed-method evidence using narrative synthesis technique. This technique organises findings and discussion around key themes, as they emerge from the studies and as previously set out in the underlying theory of change. Finally, we discuss the implications for both academics and policy makers of the findings.

This research is significant for several reasons. It is the first to provide a summary of evidence on the time burdens of agricultural practices and interventions, providing tentative evidence that agricultural interventions tend to increase agricultural time commitments. Second, it provides evidence of the complex impact of rising time burdens on nutritional outcomes and sets out key factors that determine the impact. Third, it makes a series of recommendations about useful lessons for future research on this topic, given the fragility of much of the evidence.

2. Time-use constraints confounding the agri-nutrition relationship? Three conceptual hypotheses

In this study we look at the impact of changing time burdens in agriculture, with time burden understood as an increase in overall time commitments. Time use patterns shape food consumption practices and nutritional outcomes (for example, Hull, 2013), as time is a vital input into the production, procurement and preparation of food, child feeding and childcare. In this context, if agriculture is a primary source of employment and income for many women and men, then changing time use in agriculture can affect nutritional outcomes.

The literature on agriculture and nutrition (called ‘agri-nutrition’ in much of the literature) and time use contains several conceptual hypotheses about the relationship between agriculture, nutritional outcomes and time use. The first hypothesis suggests that women spend a significant amount of time on agricultural activities in rural areas of low and middle income countries, which, coupled with other activities, leads them to experience high overall time burdens (Rost et al., 2015). Women are heavily involved in agriculture, comprising 40 percent of the agricultural labor force in low-income countries (FAO, 2011). Regional differences exist due to variation in farming systems and gendered division of labor—for instance, in sub-Saharan Africa women are disproportionately in charge of agricultural production (50 percent of labor force in agriculture) relative to other regions of the world (for example, Latin America has on average 20 percent of women working in agriculture) (FAO, 2011). Women also play a significant role in shaping agricultural and food practices due to their involvement in food production and in other stages of food provision such as food purchase, preparation, and processing. One of the most laborious activities for women in rural areas is food preparation (Barrett and Browne, 1994; Hyder et al., 2005).

At the same time, studies conducted in Africa and Asia demonstrated that women work as much as 13 hours more per week than do men (FAO, 2009). Time use studies expose women’s time poverty and unequal burdens (Blackden and Wodon, 2006; Hirway, 2010). Concerns with time constraints gave rise to debates on time-saving technologies to help women decrease their time burden and drudgery (Carr, 1978; Cecelski, 2000).

The second hypothesis is that this overall high time burden leads to time constraints and subsequent decisions about the trade-off between activities that are relevant for nutrition. Time must be divided between farming, wage work, food purchasing, food preparation and childcare, so trade-offs exist between them. For example, if women spent more time growing crops, they may have less time to prepare nutritious foods for themselves and their children. Trade-offs can be complex and unpredictable and depend on a range of factors, some of which are highlighted in recent discussion of agriculture and health linkages (Kadiyala et al., 2014). Kadiyala et al.’s (2014) review of studies from India shows that the increased income obtained through women’s wage work does not necessarily improve nutritional outcomes because women have less time to spend on child health. However, women’s

employment in agriculture may not always reduce time for childcare, especially when there are other people in the home who take on this responsibility (Kadiyala et al., 2014). Issues of seasonality and work intensity are also relevant, and may produce contradictory time use outcomes (Kadiyala et al., 2014,) and suggest that a narrow focus on time-saving technologies may not be sufficient to address women’s time burdens. Men are affected by time constraints too, but they are seen as being more able to perform their activities sequentially, whereas women may have to pursue their paid and unpaid work simultaneously (Blackden and Wodon, 2006), thus facing more severe trade-offs.

If we then differentiate donor- or government-led agricultural projects (‘interventions’) from ongoing agricultural practices, the third hypothesis is that agricultural interventions may unwittingly increase household time burdens, particularly of women, with negative consequences for nutritional outcomes. Thus, we see some concern that effective agricultural interventions need to consider the gendered impact on workloads and time constraints (Berti et al., 2004; Arimond et al., 2011). However, the evidence to understand how agricultural interventions affect women’s or men’s time is quite limited in practice. Kawarazuka’s (2010) systematic review of aquaculture interventions found limited evidence of the impact of aquaculture activities on gendered time allocation. Further, in the systematic review by Leroy and Frongillo (2007) of animal husbandry and aquaculture, only 4 of the 14 included studies have even a limited assessment of the impact on caregiver time and workload, and these show mixed impacts. Leroy and Frongillo conclude that given this lack of knowledge, it is possible that the potential benefits from any successful intervention to increase the output of animal-sourced protein may be offset by a reduction in the time available for childcare (2007).

3. Theory of change and research methodology

This study is a systematic review of available evidence on the direction and causes of impact along the pathways set out in Fig. 1.

The theory of change represented in the diagram summarizes the key linkages between agriculture and nutrition, via time use. This theory of change informed our search strategy and selection process in the systematic review, as it will be explained below. First, it illustrates that agriculture practices tend to use household labor in various ways; agriculture interventions tend to change that labor use. Changes can occur at any point in the agriculture and food value chain: in labor used in agricultural inputs (such as making mature or collecting seed), in production itself, or downstream in terms of the storage, processing, distribution or sale agricultural outputs.¹

The exact impacts on time use in agriculture will depend on various factors and will interact with existing social norms about agricultural work. For example, intra-household dynamics may affect who engages in an agricultural intervention project itself. This changing labor input into agriculture will change the overall time burdens of various household members. There may be changes in the time spent on productive activities and reproductive activities, and these may affect nutrition in various ways. Nutrition may be affected directly – by changing energy expenditure, hygiene and healthcare practices, and thereby nutritional status. Changing time burdens may change child feeding, food preparation or food provisioning.

Given the theory of change and the comment in the reviews quoted above on the limited available evidence, this research sets out to solve two problems. *debFirst, to address the lack of evidence in previous reviews, it uses an innovative approach intended to capture a wider set of data than previous reviews. As such, the review analyzed three kinds

¹ Land access and ownership shape how agriculture and time use are linked and there is a specific concern that agricultural commercialisation and land reforms or deals may lead to women losing access to land (Behrman et al., 2012). However, the discussion of land is beyond the scope of this paper.

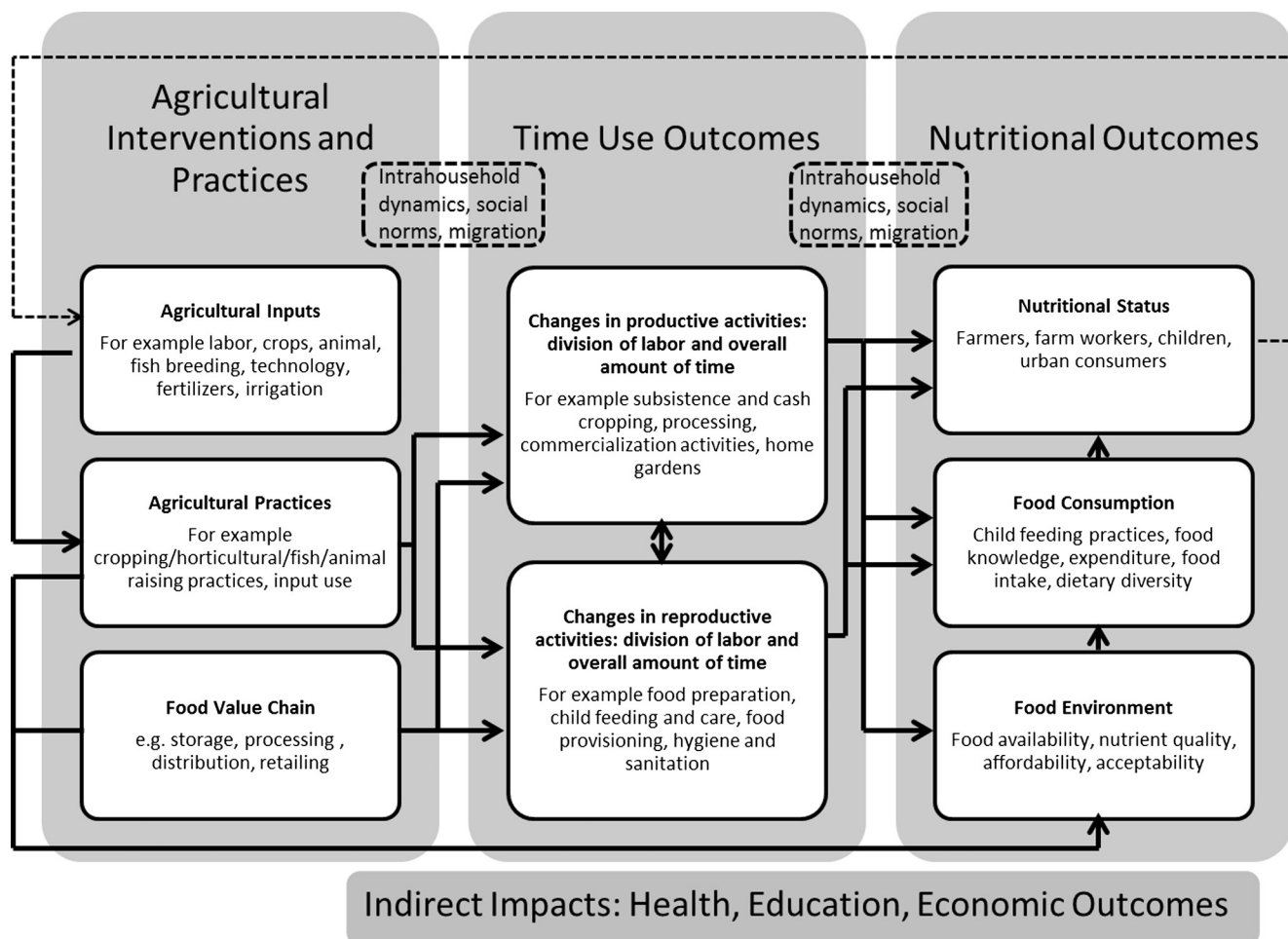


Fig. 1. Theory of change. Source: Compiled by authors.

of studies: those that look at the impact of agricultural interventions and practices on time use, those that look at the impact of time use on nutritional outcomes, and those that look at the full pathway from agricultural interventions and practices to nutritional outcomes via time use.

The second aim is focused on the inability for previous reviews to answer the question of role of time constraints. As a result this work aims to understand the impact pathway via time use change, as opposed to focusing only on the impact size. To address questions on *how* impact is created, ‘narrative synthesis’ techniques are considered more appropriate than meta-analysis (Thomas and Harden, 2008; Snilstveit et al., 2012). Narrative syntheses organise the evidence by theme and, in some cases, around the conceptual linkages outlined by the theory of change, and can be used to analyse both quantitative and qualitative evidence, in alternative to or in combination with meta-analysis (Snilstveit et al., 2012). We use narrative synthesis to identify descriptive themes, as emerged in the reviewed studies, and highlight the critical factors that mediate the causal chain linking agriculture, time use and nutrition, as set out in the theory of change. (Ibid.). Despite initial intentions to combine meta-analysis with narrative-based synthesis, it was eventually impossible to conduct meta-analysis due to the inclusion of only one randomized experiment. Meta-analysis would have expanded the scope of the review to consider the size of impact in addition to the characteristics of the impact pathway. The review was also limited at the outset to its focus on the impact of agriculture on nutrition via time, and so does not consider reverse causality, i.e. the impact of nutrition on agriculture, nor the impacts of agriculture on nutrition other than through the time-use pathway.

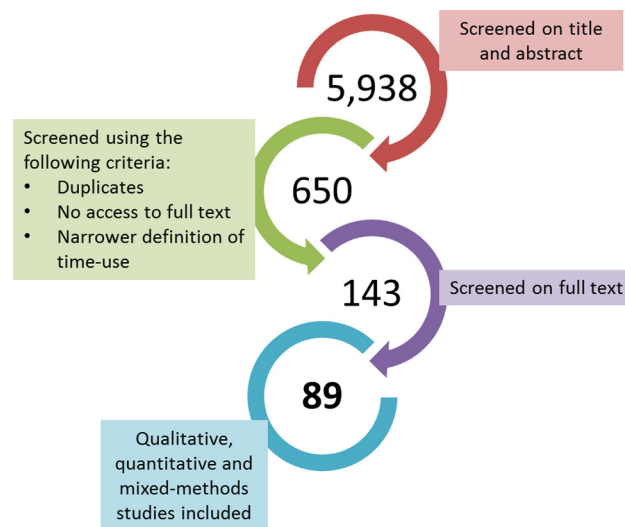


Fig. 2. Screening process. Source: Compiled by authors.

The search strategy used in this review was informed by Waddington et al. (2012). We searched a number of comprehensive databases (CAB Abstract, Scopus, Web of Science, Econlit, and Proquest) as well as websites of International Food Policy Research Institute, FAO, and World Health Organization to capture grey literature.

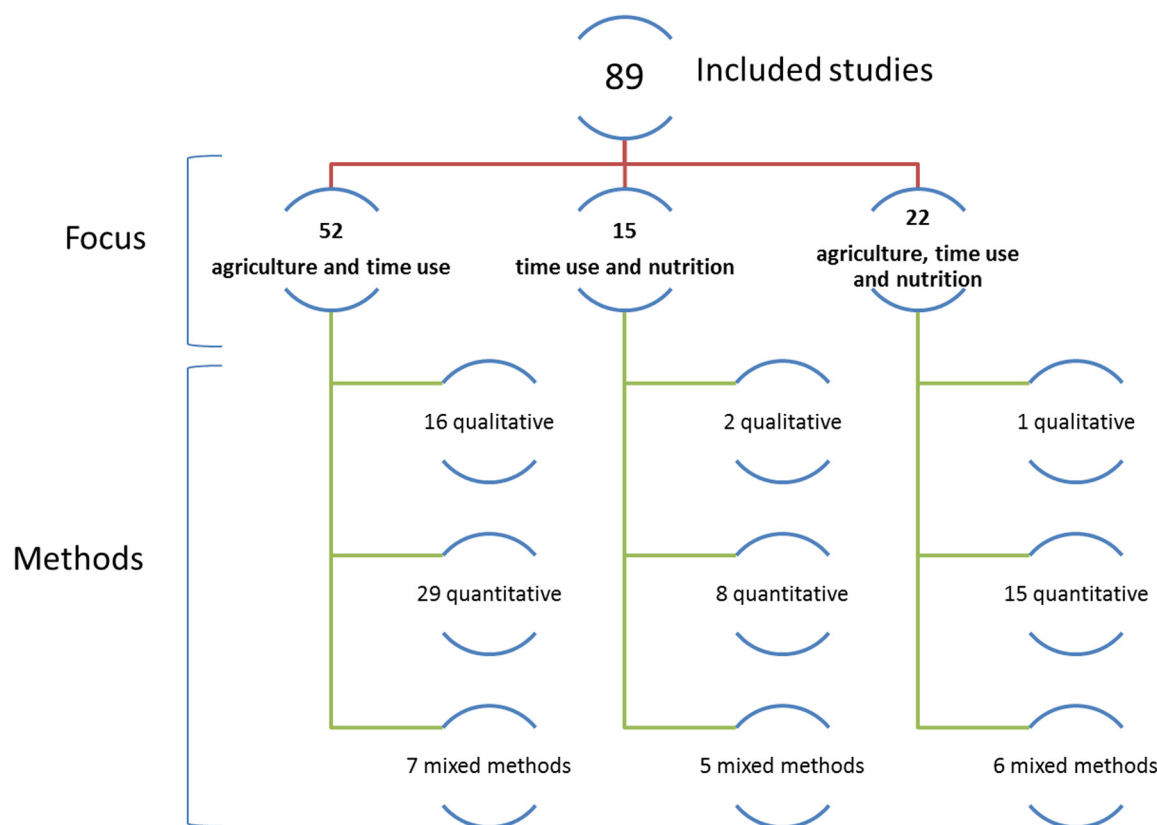


Fig. 3. Included studies, by focus and method.
Source: Compiled by authors.

The search returned 8205 studies, which were reduced to 5938 after elimination of duplicates using Eppi Reviewer. Studies were excluded if they focused on high-income countries, were in a language other than English, were focused on urban residents, and if they did not contain a formal treatment of time-use. Fig. 2 summarizes the process, while the exact distribution of reasons for exclusion are set out in Section 3 of Johnston et al. (2015).

The studies were screened on title and abstract and then read in full at a later stage. The findings of the review are based on a family of 89 quantitative, qualitative and mixed methods studies (see Fig. 3 for breakdown).

Given the objectives of the review, it was important to differentiate agricultural practices (i.e. ongoing organization of agricultural activity in various forms, including small-scale agriculture, commercial agricultural production homestead gardens, animal husbandry, fishery and so forth) from agricultural interventions (i.e. donor or government agricultural projects²). This was because of the somewhat different hypotheses that exist around each, and in particular it was important to determine if agricultural interventions increased time burdens, especially for women.

These studies were analyzed and their quality appraised using data extraction and quality assessment tools – see Johnston et al. (2015) for a full list of included studies and tools used for analysis. The quality assessment, which considers not only quantitative and qualitative evidence but also time use data, is reported in Fig. 4 below.

The quality appraisal approach is composed of three components: one assessing the quality of time use data, one for evidence from studies using qualitative methodologies and one for quantitative evidence. The quality assessment of time use data is an original element introduced by this systematic review. We constructed a time use data quality toolkit

following the format of the Critical Appraisal Skills Programme³ (CASP) checklist, which is a set of closed-ended questions. The checklist was informed by literature on time use methodology, with a specific focus on low- and middle-income countries (United Nations Statistics Division [UNSD], 2005; Esquivel et al., 2008; Hirway, 2010).

To assess the quality of qualitative evidence, we used peer review status as a proxy for quality. This seems to be more efficient than determining an ideal benchmark method to assess qualitative studies against, given the broad range of methods used in qualitative studies (Jones, 2004; Dixon-Woods et al., 2007; Thomas and Harden, 2008; Snilstveit et al., 2012). To assess the quality of quantitative evidence, the studies were classified into two types: randomized and non-randomized. For randomized studies, the 3ie (International Initiative for Impact Evaluation) risk of bias assessment tool (Hombrados and Waddington 2012) was used. For nonrandomized studies, we adopted the approach by Cirera et al. (2011) and Dorward et al. (2014) which consists of three questions to evaluate the model specification used, the methods of inference, and whether the study was peer reviewed.⁴ The model specification was assessed on the basis of: correction of endogeneity (for instance, using instrumental variables); use of non-unitary models of the household; and reliance on realistic assumptions (for example, non-perfectly competitive markets). Methods of inference were judged according to the indicators of food consumption and nutrition used. All of the studies were ranked as low-, medium-, or high-quality for each component—time use and qualitative and/or quantitative evidence (See Johnston et al., 2015 for detailed description).

³ More information on the Critical Appraisal Skills Programme can be found at <http://www.casp-uk.net/#!casp-tools-checklists/c18f8>.

⁴ The non-randomized quantitative studies used a range of methods for data analysis, including descriptive statistics, propensity score matching, difference-in-difference estimation, split half reliability test, instrumental variables, propensity-weighted ANCOVA regressions, multiple linear and logistic regressions.

² Masset et al. (2011) provide a detailed definition of agricultural interventions.

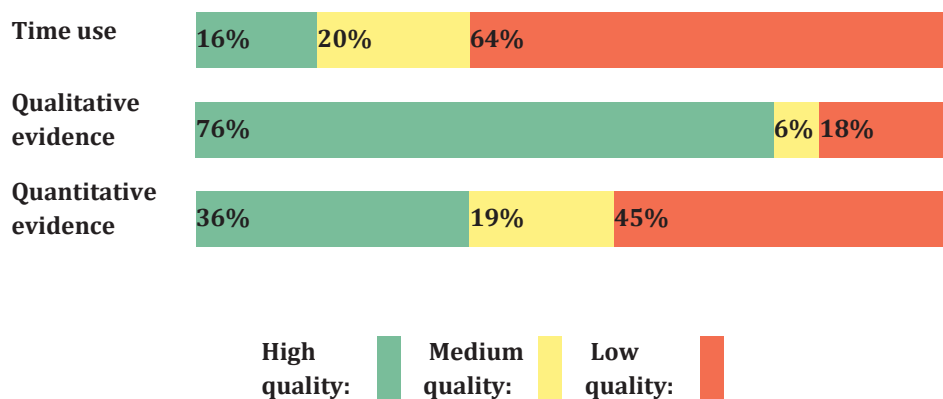


Fig. 4. Quality assessment by evidence type.

Based on the theory of change, we use a twin-track approach to the inclusion of studies. The detailed tables laying out the evidence from the studies (Tables 1 and 2 in the next section), which suggests the direction and scope of the impact effect, only include intervention studies ranked as medium or high quality. However, we include all relevant studies in our more general discussions, to be able to understand the modalities of the pathway.

4. Agriculture and gendered time use

In the literature review we noted three hypotheses: that women have a particularly heavy time burden in agriculture; that agricultural interventions may unwittingly raise time burdens; and that excessive workloads may generate time constraints that are detrimental to nutrition. In this section, we first consider the results of the systematic review on the first issue by presenting findings from 47 studies on agricultural practices and time use. Here, we use the term ‘time burden’ to refer to the amount of time spent on a particular task. How an increase in the time burden for one activity relates to an overall increased time burden (i.e. across all activities) and then to time constraints is discussed in later sections.

What is women’s contribution to agricultural work and how has it been changing over time? We look at the studies that consider women’s participation in agriculture to address this question. The evidence demonstrates the importance of women’s participation in particular branches of agriculture, and the increase in this participation in some settings. A good example of a study that looks at increases in participation is, Gunewardena (2010), which uses time use survey data in combination with in-depth qualitative analysis to describe gender division of labor and community roles in Sri Lanka in relation to commercial sugarcane production. The study shows that the shift to commercial sugarcane production has brought about a process of feminization of agricultural work. Women are employed on low-status work and spend long hours in the fields, performing exertive tasks. Gunewardena argues that commercial sugarcane cultivation has led to reconfigurations of gendered division of work with detrimental effects on women’s status and physical well-being. Other studies look at small-scale farming in Pakistan (Luqman et al., 2012); commercialized potato production in Punjab, India (Jethi, 2008); livestock production in Kenya (Roberts, 1996); mixed farming, cropping, and livestock in Iran (Fami, 2006); and Kanwar et al. (2003) look at time spent in agriculture by hill farm women in India.

Do women spend a high proportion of time on agriculture in relation to other activities or in relation to men? In this case, we are helped by studies that conduct a comprehensive investigation of time use patterns, which look not only at gendered time spent in agricultural activities but are concerned more broadly with allocation of time to nonagricultural activities, housework, or both. For example, Mishra and Mishra (2012) study the relationship between deforestation,

agricultural activities, and housework, with a specific focus on women’s burden in India. Processes of deforestation are associated with complex gendered work burdens. On average, women are found to spend more time than men on farming, forestry and labor sharing but men spend more time on wage labor. Women in deforested villages spend longer working hours in agriculture-related activities than women in non-deforested villages. Newman (2002) studies the time use effects of the cut-flower industry in Ecuador. In this study, women’s work in the cut-flower farms is associated with increases in time spent by men on unpaid housework. Korovkin (2003) also looks at the cut-flower industry in Ecuador and reaches more pessimistic conclusions based on the finding that women workers face reduction of time spent with their families and community, with broader negative implications for women’s status within their households and villages.

The key finding is that in most studies women contribute a large share of their time to agricultural work. Further, to investigate the extent to which women were likely to experience time constraints relative to men, many studies found women to have higher total workload burdens than men (i.e. across all activities, not only agricultural). There are four limitations of this literature that must however be taken into account. First, few studies assessed the full range of time allocation by women, with a minority investigating employment in nonagricultural activity, for example. This makes it hard to draw wide conclusions about the extent to which agricultural activities dominate women’s time. Second, some studies do not collect data on men’s time use and so it was hard to draw comparisons between men and women in all cases. Third, many studies did not include any indicator of socioeconomic status. An important exception by Zaman (1995) looks at patterns of time use in rural Bangladesh by class, gender and season and finds that richer rural households have different time use patterns compared to the poorer and landless, with the latter engaging in agricultural wage work. Wealthier households are likely to have more resources to respond more effectively to increased time demands, through hiring labor for agricultural and domestic work. Fourth, not all studies took into account seasonality of work activities even though we have some evidence of its importance. For example, Wodon and Beegle (2006) look at seasonal labor shortages in Malawi and find that it is in the peak agricultural season that women’s overall time burdens are greatest.

The second hypothesis that we can investigate is whether agricultural interventions tend to increase time burdens of women or other household members. Our search found only nine studies of the impact of agricultural interventions recorded how time use changed as a result. However, three were removed due to concerns about the quality of the methodology. The remaining six studies (that were assessed as having medium or high quality methodologies) are summarized in Tables 1 and 2 (see below). Note that the three studies in Table 1 shows the link between agricultural interventions and time use change, while the studies in Table 2 shows the full link between agricultural intervention, time use and nutritional outcome.

Table 1
Agricultural interventions and time use.
Source: Compiled by authors.

Study	Agricultural intervention	Time use outcomes				
		Farming	Waged agricultural work	Nonagricultural work	Domestic work	Leisure
Admassie and Bedi (2003)	<i>Introduction of agricultural technology; machinery; improved seeds; Ethiopia</i>	↓ children (girls and boys) ↑ girls	Not reported	Not reported	Not reported	Not reported
Dammert (2008)	<i>Anticoca policies; Peru</i>	↑ children	Not reported	↑ men	↑ children	Not reported
Riley and Krogman (1993)	<i>Irrigation projects to promote vegetable production; Lesotho</i>	↑ women	Not reported	Not reported	↓ women	↓ women

Note: ↑ = increase in the outcome variable; ↓ = decrease in the outcome variable; → = no effect on the outcome variable; Not reported = not reported in the study.

Table 2
Agricultural interventions, time use, and nutrition.
Source: Compiled by authors.

Study	Agricultural intervention	Time use					Nutrition				
		Farming	Waged agricultural work	Nonagricultural work	Domestic work	Leisure	Childcare/feeding	Calorie intake	Nutrient intake	Child nutrition	Adult body mass index
Paolisso et al. (2002)	<i>Vegetable and Fruit Cash Crop program; Nepal</i>	↑ women and men in hhs with one preschooler	Not reported	Not reported	Not reported	Not reported	↓ hhs with one preschooler → hhs with more than one preschooler	Not reported	Not reported	Not reported	Not reported
Kumar (1994)	<i>Adoption of hybrid maize; Zambia</i>	↑ women and men	Not reported	Not reported	↑ women	Not reported	↑ hh expenditure	↑ hh expenditure	↑ hh expenditure	↓ seasonally (worsening stunting, wasting)	↓ seasonally women and men
Quisumbing et al. (2013)	<i>Strengthening the Dairy Value Chain Project; Bangladesh</i>	↑ women and men	Not reported	Not reported	Not reported	↓ in relation to control group CI	Not reported	Not reported	Not reported	Not reported	Not reported

Note: ↑ = increase in the outcome variable; ↓ = decrease in the outcome variable; → = no effect on the outcome variable; Not reported = not reported in the study; hh = household; hhs = households.

Different types of intervention are analyzed in each study; ranging from agricultural extension schemes to intensification of livestock production and fishery. The common feature is that all interventions seek to promote agricultural commercialization, although they do so in different ways. Kumar (1994) studies the impact of adoption of hybrid maize in Zambia. Paolisso et al. (2002) study a cash crop program aimed at commercializing food and vegetable production in Nepal. Quisumbing et al. (2013) look at the Strengthening the Dairy Value Chain Project, a program aimed at intensifying livestock production and dairy-related activities in Bangladesh. Most of the studies then compare households in a treatment group with households in a control group, with appropriate remedies to deal with selection bias (remembering that we have chosen to include only high or medium quality studies in our main tables – see the discussion of quality above).

All of the studies focused on employment in agriculture, with variations in terms of own-account farming, wage labor, and family labor (defined as labor that is sourced from members of the family rather than recruited externally through the labor market). Distinction between different types of agricultural work is clear in some studies, such as Riley and Krogman (1993), and much less so in others. Only three of the seven studies took domestic work into account, with some recording time spent on particular activities such as child feeding practices (Paolisso et al., 2002; Quisumbing et al., 2013) or, more broadly, by reporting time spent on a range of reproductive and household maintenance activities (Kumar, 1994). Little attention is paid to non-agricultural work. Although the focus is on agriculture, to understand overall changes in time burdens and subsequent time constraints, we need a wider picture.

The majority of these studies are concerned with women's agricultural work and time allocation. Some studies also collected data on other household members. When looking at intrahousehold time allocation, some studies use gender-disaggregated data to compare the time spent by women and men on a range of activities (see Kumar, 1994; Quisumbing et al., 2013). Two studies, Admassie and Bedi (2003) and Dammert (2008), focus specifically on children's participation in agricultural work.

Three studies report information on life cycle. For example, Kumar (1994) underlines the difference in the nutritional and health status of children younger than five years old and older children, and suggests that the second group's worse nutritional status may be associated with seasonal participation in agricultural work. Despite the fact that we might expect agricultural activities to vary seasonally, only two of these studies look at seasonality and find important season-related variations in type and intensity of agricultural work, time use, and nutritional outcomes.

In general, it was clear that in the four studies that reported the impact on women, the time burden in agriculture was increased following the intervention, although in Paolisso et al. (2002), this was only for women in households with one pre-schooler. Two important issues should be noted. First, without better information on other uses of time, we do not know if increased time in agriculture lead to increased time burdens overall. Only in Riley and Krogman's (1993) study of irrigation vegetable production in Lesotho we get a fuller picture, and this shows that women's time in agriculture increased, and although their time in domestic work fell, their leisure time was reduced. Secondly, the impact of rising agricultural work burdens was not limited to women, as it rose for all the other groups for whom projects measured time burdens, with exception of the paper by Admassie and Bedi (2003), where workloads went up for girls, but down for boys. This is not enough evidence to draw a strong conclusion that agricultural interventions tend to increase overall time burdens. There is limited evidence to suggest that in some cases agricultural interventions are associated with increased time spent on agricultural activities, however, further primary research is needed.

5. Changes in time use and nutrition

In this section, we look in more detail at the studies that tell us about the nutritional impact of changing time use. Despite the simple hypotheses discussed above, studies show a complex relationship between demands on time and nutritional outcomes, not least because a range of nutritional outcome variables are used. It is worth giving some flavor to this complexity from the sub-set of studies in Table 2 (all of which are deemed as being of medium or high quality). Some studies found that increasing time burdens (not only of women but also of others in the household) had a negative impact on indicators of nutritional outcome. So Paolisso et al.'s (2002) evaluation of a vegetable and fruit cash crop intervention found that it led to more time in agriculture, with a negative effect on the care time for preschoolers, although this trade-off was not so apparent for households with more than one preschooler. Kumar's (1994) study of the adoption of hybrid maize found that five- to ten-year-old children present higher levels of seasonal malnutrition in adopters' households, and that this was due to seasonal increases in workload for all household members.

However, if we look at the wider cohort of 37 studies that relate time use to nutritional outcomes, some studies found that greater time burdens were associated with improved nutritional outcomes. For example, Blau et al. (1996) study the impact of labor supply decisions by mothers in a rural area of the Philippines and find that if more time spent in work leads to higher wages for mothers, then there could be positive implications for children's health. In other studies there seemed to be no relationship between patterns of time use and nutritional outcomes. Thus, Bamji and Thimayamma's (2000) study in rural South India found no statistically significant impact of women's time in work on child nutritional outcomes.

Indeed in this, the findings of this review are similar to other reviews of the relationship between women's employment and child health (Coreil, 1991, 222; Blau et al., 1996, 91). This lack of an overall relationship may result from several methodological factors. First, time use data may be of poor quality (Peterman et al., 2013, 422; Stevano et al., 2018). Second, time burdens may be seasonal (as found in Kumar's, 1994 study) but studies may not be designed to pick up seasonal factors. Third, studies of time use change often do not identify which activities can be done simultaneously with child care and which are in competition with child care (Stevano et al., 2018). Where studies do allow for an investigation of simultaneity, we see the importance for an understanding of relationship between time use and outcomes. For example, Peterman et al. (2013) suggest the lack of relationship between pregnancy and physically demanding activities may be due to the fact that many activities in rural areas may be carried out simultaneously. Similar in the study by Nti et al., 1999, the authors suggest that the majority of rural working women seek to manage time burdens by synchronizing tasks.

Aside from methodological issues about study design and the way that time use is theorized, there are also several analytical factors that may lead to an indeterminate impact over one or more samples. First, the impact of restricted care time on child nutritional outcomes may depend on the age of the child. This is noted by the authors of several studies (Kumar, 1994, Ricci et al., 1996; Paolisso et al., 2002). Coreil (1991) suggests that there is clearer evidence that infants might suffer if there are additional calls on a mother's time, whereas older children may do better if the extra time burdens lead to higher household income.

Second, the household structure has significant impacts, not only in determining the exact nature of care burdens (such as the number of children living in the household Paolisso et al., 2002) but also the number of possible caregivers. The importance of this is clearest if we consider the impact of time burdens on a mother's childcare activities. A number of studies point to the importance of nonmaternal caregivers

who are willing and able to take up care roles. Keng and Lin (2005) note that female employment is less likely to lead to a shift to spending on food consumed away from home if grandparents are present, but more likely to if there are children in the household, reflecting the relationship between time constraints and food provisioning is affected by household composition. Zycherman (2013) points out the differences in time use not only between married and single women (and women with and without children) but also between senior and junior women within one household. In her study of a village of rural Bolivia, she finds that junior married women are able to engage in a greater amount of productive activity as senior married women take care of their children. Nti et al. (1999) note that rural working women were likely to use their parents or older children for childcare, and older children often carried out other household tasks, such as fetching water, cooking, and cleaning. Finally, Gryboski's (1996) study in rural Java reminds us that a wide range of nonmaternal caretakers can be involved in infant care, particularly the grandmothers, sisters, and fathers of the infants. However, Gryboski (1996) suggests that the influence of non-maternal caregivers is affected by social norms about appropriate practices. Thus, the studies would seem to agree with Coreil's (1991) overall conclusion that increasing time burdens for some individuals in the household will have diverse impacts on child health as a result of varied household composition.

It is also clear that income may mitigate the impact of higher time burdens, and richer households may find ways to mitigate time constraints by using income to purchase food or buy in child care. In Nti et al.'s (1999) study, a few of the women in better paid employment were able to use paid village day care facilities which reduced their time constraints. Indeed, some factors that increased time burdens (e.g. increased female employment) also could directly raise income. Blau et al. (1996) argue that the income effect dominates the time constraint effect, so that mothers who go engage in wage work tend to be those with higher incomes and that this has a positive impact on child health. Desai and Jain (1994) remind us that the relationship between women's work and child health should not ignore class and economic characteristics, as this affects the selectivity into employment, the remuneration of employment, and other household characteristics.

A final analytical issue is that in drawing a close link between changing time use in agriculture and changing time for nutrition-related activities, we are neglecting the other time burdens that individuals face and the way that time constraints emerge. As Desai and Jain (1994) argue, we should not use simple binary models of women's economic time and childcare, relating the two in a dichotomous manner. Desai and Jain (1994) remind us that women face many work burdens and that women's other domestic responsibilities are likely to reduce their childcare time. In their study, non-childcare domestic tasks proved to be significant consumers of women's time, and they argue that few rural women are able to devote their domestic time solely to childcare. This is similar to the results of the study by Bamji and Thimayamma's (2000). They found that working women carried out the same amount of childcare compared to nonworking women. There were two underlying reasons for this. First, nonworking women also were involved in many activities and so had numerous calls on their time. Second, working women reduced their own sleep and leisure time to manage their workload.

It would be useful to have a wider picture of the implications of increasing agricultural time burdens. Do they lead to a reduction in other domestic tasks, such as fuel wood collection, laundry etc.? What are the most significant users of time in households? It may be that time use in agriculture is only a small proportion of the working day and that any time saved in agricultural activities would be used in other domestic tasks rather than in child feeding, cooking and child care. We also do not have a picture about the way that time burdens lead to time constraints overall, such that trade-offs are made, a discussion of these issues is developed in Stevano et al. (2018). However, the methodology of studies limits our ability to draw conclusions, as few had a

comprehensive investigation of time use patterns.

Finally, we should note that many of the studies were focused on the impact of increased time burdens on children within the household rather than women or men. However, we might be interested in knowing more about how increased workload affected women and men's health for reasons of gender parity or for inter-generational health. Some studies give us glimpses of the issues. Fourteen studies measured the energy intensity of agricultural work, although they do not present a uniform picture of the relative arduousness of such work and hence of the direct impact on nutritional status of high agricultural workloads. For example, Fami et al. (2002) and Higgins and Alderman (1997) show that women's energy balance is in deficit when they engage in intensive agricultural work. Barrett and Browne's (1994) study of the introduction of village cereal mills in the Gambia suggests that the energy saved by women is possibly more crucial than the time they save by using village mills. They estimate that the energy demands of hand grinding meant that rural women spent much of the year in calorie deficit. However, one study (Headey et al., 2011) reports that the body mass index of women working in agriculture is not that different from those of women employed in other sectors in India. Clearly the nature of agricultural work differs. Without knowing more about the energy intensity of activities, we cannot conclude that policies that concentrate women's time in agriculture are directly having negative impacts on their health status compared to other activities. However, if overall work burdens are increasing, there is some evidence that this has negative health impacts via stress and anxiety. Coreil (1991, 231) argues that the demands of filling multiple roles taxes women's physical and mental health. Bamji and Thimayamma (2000) find that working mothers slept and relaxed less than others, while Nti et al. (1999) point to the energy expenditure and physiological problems that working women experience to fulfill their multiple roles.

6. Discussion of the links between agriculture, time use, and nutrition

In this section, we discuss what can be learned from past studies and how future studies can address research gaps. We used a narrative synthesis approach to identify the themes that are critical for our conceptual understanding on the linkages between agriculture and nutrition via time use. While the evidence is too diverse, or limited, to clearly confirm or reject the three hypotheses outlined in the second section, the evidence does not describe a simple story on the nutritional impacts of agriculture via time use. However, we do not find unequivocal negative shifts in nutritional outcomes due to women's greater engagement in agricultural work via increased time-use burdens. Why? Nutritional impacts are varied because households and household members respond to increased time burden and workload in different ways. In turn, responses are different because there are important differentiating factors that mediate the relationship between agriculture, time use, and nutrition.

We identify a number of key differentiating factors. First, time constraints can be offset by income because households can purchase more food, possibly more nutritious foods, hire domestic servants, and in the case of farming households, hire agricultural workers (Kadiyala et al., 2014). Obviously, the possibility of using income in any of these ways depends on income levels and uses. Some of the studies included in this review find that agricultural interventions have no effect on household food consumption (Bellin, 1994) or are associated with improved food consumption, measured as calories and nutrients intake despite leading to increased time spent on agricultural activities (Kumar, 1994). Indeed, increasing time burdens may result in a shift in household food provisioning away from home-grown or home-prepared foods towards purchased foods. In some cases overall calorie intakes may increase, but the indicators of nutritional status used in surveys are relevant and we may be interested in the long-run macro- and micro-nutrient impacts of a shift in dietary patterns. Of course, household

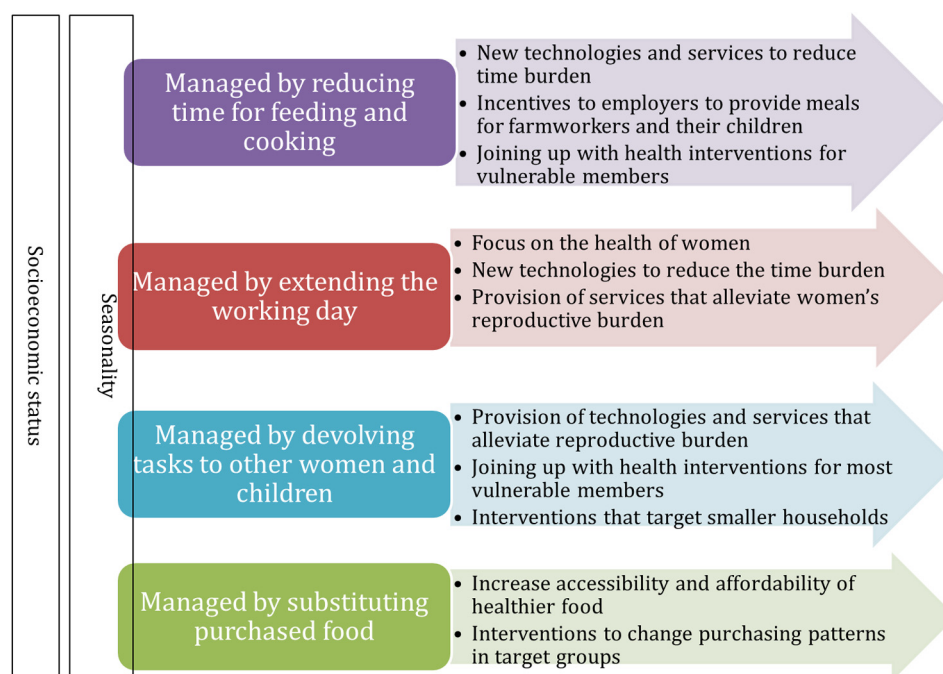


Fig. 5. Modes of management of increased agricultural time burdens and consequent policy responses.
Source: Compiled by authors.

socio-economic status is relevant in charting the income-effects, and this suggests that socioeconomic status needs to be measured carefully.

Second, it is important to differentiate between children's and women's nutritional outcomes. Although women's and mothers' time burdens may not have significant negative effects on children's nutrition, increased workloads in agriculture may still have negative consequences on women's nutrition and well-being. Nutritional impacts may also change depending on the type of indicator used. Different indicators show opposite results. For example, in Kumar (1994), household calorie intake measures improved, while nutritional outcomes worsened. This suggests that the choice of indicators is important and that a combination of indicators of food consumption and nutrition may yield a more accurate picture of nutritional impacts.

Third, household composition matters. Time constraints of some household members may be minimized or offset by the presence of other household members who can take up unpaid care work that can no longer be performed by those more involved in agricultural work. In addition, many of the studies on time use and nutrition underline the importance of nonparental and nonmaternal care. A specific study of the mechanisms of replacement is important, as it can be expected that these take place along lines of power such as age and gender. Mechanisms of intra-household labor allocation and substitution are in turn mediated by societal norms and perceptions on the value of women's time. Recent work in time use research seeks to illuminate how norms and decision-making interact with time allocation (Seymour and Floro, 2016), and it would be interesting also to connect this to nutritional outcomes.

Another differentiating factor that emerges from the evidence reviewed is seasonality. As exemplified by specific examples in previous sections, many of the included studies that take seasonality into account find important seasonal variation in both time allocation and nutritional outcomes. This suggests that time constraints as well as energy balance, nutrient intake, and nutritional outcomes can be seasonal. Therefore, they need to be measured and remedied at appropriate times.

Future research on the time use linkages between agriculture and nutrition should take account of the differentiating factors. It is clear that, while time use is important, its nutritional impacts are mediated

through the income channel and intra-household dynamics. The nutritional consequences also vary by indicator, seasonality and work intensity. The evidence reviewed provides scattered insights on these issues but we need to know more about these interactions.

Despite the complexity of the picture, there are policy considerations to be discussed. The evidence shows that the nutritional impacts are varied because households and household members respond to increased time burden in different ways. Therefore, the identification of the ways in which burden is managed is the starting point for gender-sensitive agricultural policy for improved nutrition. We argue that different sets of policies are needed to address specific forms of burden management, shouldered by households, individual household members, or both. Fig. 5 summarizes the different ways in which burden is managed, as they emerged from the systematic review, and draws policy implications for each of them.

Some studies⁵ find that a response mechanism to increased time spent in agriculture is simply an extension of a women's working day and the simultaneous erosion of resting, sleeping, and leisure time. Therefore, the policy implications in this scenario should try to limit the extension of the working day. This would include the introduction of technologies that can save time in agriculture, reproductive tasks, or both; health policy focused on women or other household members affected by lower leisure or sleep; and the provision of services (for childcare, for instance) that alleviate women's reproductive burden.

Another possible response is the increased consumption of purchased foods. In some cases this has led to an overall increase in calorie consumption. However, we may also be concerned that this leads to dietary change, with increasing consumption of goods high in fat, sugar and salt. In contexts where this type of response is common, policies should be aimed at ensuring that purchased foods are affordable and nutritious. Therefore, regulation and incentives can be used to guarantee accessibility and affordability of healthy and nutrient-rich processed foods as better substitutes for foods that require longer

⁵ This response mechanism is explicitly discussed in four studies (Riley and Krogman, 1993; Desai and Jain, 1994; Nti et al., 1999; Bamji and Thimayamma, 2000), which are, however, the only studies that report on women's leisure, sleeping and resting time.

preparation. In addition, the most affected groups, such as the poorest households, could be targeted with programs to increase their purchasing power.

In some cases, increased time spent in agriculture results in a reduction of time for feeding and food preparation. This can affect the individuals whose time is reduced as well as their children and families. Women's time is especially sensitive in this case as women are primarily responsible for feeding and food preparation across the world. Interventions could include the provision of time-saving technologies in agricultural and domestic work, incentives to encourage employers to provide meals to farmworkers and their children, and health policy focused on the most vulnerable in the affected households. Importantly the additional burden is often managed by devolving tasks to other members of the household, especially younger or older women and children. In this scenario, members of smaller households may need to shoulder greater burdens, and therefore smaller households may be the appropriate target of interventions.

Overall, available technologies can make a difference in households' responses to increased time burdens. If households can access technologies that allow them to gain time savings in those activities, such as domestic work, that are particularly critical, then the ways in which increased time burden and workload are experienced can be different. Technology by itself is nevertheless insufficient to address the various negative implications of longer working days. The availability of time-saving technology does not ensure that the overall working day (of women, in particular) will be shortened, as it may simply allow women to reduce the burden of one activity and then replace it with another. To understand why this might happen, we need a broad view of government social policy and prevailing economic constraints and a picture of men's contribution to the household.

7. Conclusions

The paper's main contribution is a summary of the lessons learned from past studies of the linkages between agriculture, time use, and nutrition outcomes. This article looks at whether changing time burdens are an explanation for the agriculture-nutrition disconnect. It confirms previous research on the importance of women's agricultural role, and provides new evidence that agricultural interventions may tend to increase time burdens of beneficiaries. However, it suggests that the link between time burdens and nutrition is complex, and so argues that increased time burdens may be one explanation for unintended negative consequences of agricultural interventions in some settings but not in all. While we have discussed various research needs, the paper ends by suggesting a road-map for research on gender-sensitive and nutrition-sensitive agricultural interventions.

Based on the mapping of the evidence on agriculture, time use, and nutrition, there are several implications to be drawn for future research in this area. First, time use data needs to be improved, particularly in the attention paid to simultaneous activities and the inclusion of measures of work intensity (Jackson and Palmer-Jones, 1998). At the same time, time-use data needs to be married with other indicators that allow impacts to be differentiated across socio-economic status and activity type (Hirway, 2010). Second, the study also shows that future research on agriculture and nutrition would benefit from the simultaneous use of different indicators, such as calorie intake, dietary diversity, and anthropometric measures. Third, given the overwhelming focus on women's time use among the studies we found, future research includes other household members, as well as considering diversity among women. Future research in this area should collect time use data for not only women, but also other household members, ideally all. Crucially, descriptive data on individuals' use of time should be married with analyses of intra-household allocation of labor, particularly on how time use may change as the result of adoption of time-saving technologies. It is also important to study the relations of power between older and younger women, as age may be as significant as gender in

determining the intra-household division of labor. More work must also be done to understand men's time use, and we were surprised at how few studies focused on men.

In the process of screening several thousand studies, we excluded many studies on time use and nutrition because they were focused on urban areas. There may be a mistaken assumption that time constraints and the associated changes in food consumption are urban phenomena. Also very few studies focused on food processing or retailing. It seems important that research on agriculture, time use, and nutrition develops also along the segments of the food value chain.

Some of the limitations of the review derive from the limitations in the quality of the studies. Problems with the employment statistics described in the previous section may obscure important aspects of participation in the agricultural and nonagricultural sectors. The food and nutrition indicators used were different across the studies, and therefore there are limits to the conclusions that can be drawn on impacts. Also, given the limitations of the studies, we were not able to differentiate between short- and long-run effects. For example, it may be the case that in the short run the increase in time burdens prevails and has an effect on nutritional outcomes but in the long run the income effects may dominate.

Two final issues must be raised. While this study arises from an interest in informing nutrition-sensitive agricultural policy, it is also true that the most pressing time burdens may not emanate from agriculture. In this respect, some of the more comprehensive time use studies in our search are illuminating—and they tend to show that reproductive activities dominate time use. Also, given that rural employment in nonagricultural activities is increasingly relevant in low and middle income settings, agriculture may not be the predominant occupation for rural inhabitants and so not a major time burden.

At the same time, our underlying thesis may be remiss in its vision of trade-offs in time use. In this systematic review, we have investigated how agriculture draws on the time of women, men, and children and what the nutritional implications are. This encompasses a somewhat simplistic vision of trade-offs. For example, if a case study were to show the example of an agricultural intervention that raised agricultural work burdens and increased nutritional outcomes but reduced the leisure time for women, should we categorize it as a positive or negative example? Does our focus on nutritional outcomes mean that we should ignore other aspects of individual or household wellbeing? More quantitative and qualitative research would contribute to a better understanding of the links between agriculture, time use, and household welfare.

Acknowledgements

Funding for this research came from Agriculture for Nutrition and Health (A4NH) at International Food Policy Research Institute (IFPRI), and from the UK Leverhulme Centre for Integrative Research into Agriculture and Health (LCIRAH). The authors are grateful to advice from the project advisory board (see Johnston et al., 2015) and to comments at earlier conferences where this paper was presented.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.foodpol.2017.12.011>.

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