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A Cross Country Analysis of Women's Time in Reproductive and Productive Work and Maternal and Child Nutrition

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1. Introduction

There has been an increasing attention given to studying the links between agriculture and nutrition, in an effort to stipulate the conditions in which agricultural and non-agricultural programs could improve nutrition. Kadiyala *et al* (2014) outlines six pathways in which agriculture and nutrition are connected. Two of the six pathways specifically address women's time use and nutrition in agriculture.

One of the agriculture-nutrition pathways proposes that increasing women's engagement in agriculture contributes to child under-nutrition by reducing women's reproductive time to prepare nutritious food and care for children, and to breastfeed young infants (Kadiyala *et al.,* 2014, Headey *et al.,* 2011). Given that social norms dictate that women provide the bulk of care work, if women do not have enough time to collect water and fuel required for clean food preparation and to carry out good hygiene and sanitation practices, it could have a detrimental effect on the health of their children and other household members (World Bank 2008). Further, by facing a time constraint, women are unable to have children vaccinated, receive antenatal care and regular health check-ups, or access government food and nutrition programs (Glick 2002, Smith *et al.,* 2003). Children may be cared for by other family members, but the quality of their care could be worse than maternal care especially when the child is an infant or if they are cared for by older children (Glick 2002, Headey *et al.,* 2011).

However, there is little evidence or studies to corroborate the linkage between lack of women's time in reproductive work and child and maternal nutrition, most likely due to the lack of data which contains child nutritional status and women's time spent on reproductive work (Kadiyala *et al.,* 2014, Headey *et al.,* 2011).

Using data from seven countries (Bangladesh, Ghana, Ethiopia, Haiti, Nepal, Uganda and Zambia), the objectives of the study are to examine the conditions in which the lack of women's time in reproductive work leads to poorer maternal and child nutrition; and the degree to which women's time in agriculture or productive work improves or adversely affects maternal and child nutrition. The level in which women's reproductive work influence nutrition may depend on the type of reproductive work involved, such as care, cooking and other domestic chores. Similarly, the result may

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depend on type of productive work, such as agricultural work, or working as an employee, or owner of a business. Therefore, our analysis assesses the impact of time spent on nutrition, by disaggregating different types of reproductive and productive work.

Section 2 outlines the conceptual framework. Section 3 discusses the data and descriptive statistics, and section 4 lays out the empirical methodology. Section 5 presents the results, and section 6 concludes the paper.

2. Conceptual framework: Maternal reproductive and productive work on nutrition

Women's time in productive work and nutrition

Increasing women's engagement in agriculture and productive work is expected to negatively impact maternal and child nutrition through women's lack of time in reproductive work. On the other hand, it could improve nutrition if the productive work improves the availability of food or income.

Women's reproductive work and maternal and child nutrition

When faced with a time constraint, women may not be able to fetch clean water and firewood for cooking or prepare nutritious and healthy foods in a sanitary way. They would not have time to take care of young infants or breastfeed them. They may not be able to take children to have them vaccinated, to access regular health check ups, or to have access to health information. Further, they may not have time to reach markets to purchase a variety of foods, which in turn affect their diet diversity. Therefore we expect that women's time spent in domestic chores, care, shopping and getting services to have a negative effect on nutrition practices and nutritional status.

Some of the negative effects on nutrition and nutrition practices could be ameliorated if certain domestic chores and care of children are substituted by other household members (Heady, Chiu and Kadiyala 2011).

Given heavy work burdens and time constraints, women may prioritize feeding and caring of children and others, over their own nutrition. In this case, the effect of women's time in reproductive work could have a different effect on child nutrition from their own nutrition.

3. Data

The study will use the Bangladesh Integrated Household Survey (BIHS) (2012) and population based surveys (PBS) in the USAID Feed the Future in USAID's Zone of Influence (ZOI) in Ethiopia, Ghana (2012), Haiti, Uganda and Zambia, and a baseline survey of a USAID funded nutrition programme called *Suaahara* in Nepal (2012).

3.1 Survey design

These datasets collected information, amongst others, on household and individual characteristics, food security, and maternal and child nutrition. For the USAID Feed the Future surveys in Bangladesh, Ethiopia, Ghana, Haiti, Uganda and Zambia, primary female and male household members, usually the household head and spouse responded to questions about their time use, the degree of participation in decision-making in key economics activities, and group participation which are part of the Women's Empowerment in Agriculture Index (WEAI) questionnaire (Alkire et al, 2013). The only exception to this is the *Suaahara* survey in Nepal, which interviewed mothers of children below the age of five, and their husbands, if available (Cunningham et al, 2013).

Two stage probability sampling methodology was used by first identifying the enumeration areas (EA), and then a random sampling was used to identify the households within the EA.

3.3 Sample characteristics

The sample includes households with primary male and female decision makers present, and therefore excludes female-headed households.

To evaluate whether the effect of time in reproductive and productive work on nutrition depend on the type of activities (such as agricultural and non-agricultural), the sample includes households engaged in either agricultural or non-agricultural activities, or both. The geographical areas cover rural and urban households. In order to assess the impact of time allocation on women's dietary diversity, the sample is further restricted to women in the reproductive age of 15 – 49 following standard practice for women's dietary diversity (cite source). To estimate the effect of mother's time on child nutrition, we restrict the data to children whose mothers were respondents so that there is a direct link in evaluating women's time allocation decisions given household responsibilities.

Bangladesh

The Bangladesh Integrated Household Survey, conducted in 2011-2012, is representative of the rural areas of the seven administrative divisions (Sraboni et al 2014). It used a two stage sampling design to first allocate and select 275 primary sampling units

(PSUs) among the seven divisions, and select 5,503 households within each PSU (Sraboni et al 2014). We restrict our analysis to households with a male respondent, and that gives us a sample of 3,466 women.

Table 1 provides the summary statistics for Bangladesh. Women consume about 4.0 food groups out of 9. A third of children aged 6 to 23 months have a minimum dietary diversity (34 percent), while only 20 percent have a minimum acceptable diet. The percentages for boys are slightly better than for girls.

Women have on average 3.4 years of education. 5 percent of them are pregnant and 24 percent are lactating. 12 percent of households are Hindu.

16 percent of heads of households are agricultural day laborers, while 14 percent are traders. There is substantial involvement in agriculture among respondents. 75 percent of male respondents have engaged in agricultural activities in the last 12 months, and half of them have participated in non-farm economic activities. About two-thirds of women (68 percent) have engaged in agricultural activities in the last 12 months, while about a quarter have participated in non-farm economic activities. There is some scope for wage work, since 30 percent of women have taken part in wage employment.

In this study, we define reproductive work to be the sum of activities related to cooking, domestic work (including fetching water and firewood), caring for child/adult/disabled, shopping and getting services. Productive work is defined as the sum of farming, fishing, livestock, working as employed, owner of a business and weaving, textile or sewing.

The categorization of agricultural activities for Bangladesh varies slightly from this definition in that while all crop farm related activities (including home gardening) fall under farm activities, off-farm activities (including off-farm post-harvest activities) are included in domestic work, even if it is drying paddy from the harvest. Further, the activity list does not have a category for livestock rearing, and this falls under owning a business.

The descriptive statistics show that women allocate a considerable amount of time in reproductive work and off-farm activities during the last 24 hours. On average, they spend 4.6 hours (279 minutes) on domestic work and off farm activities. During the survey duration of December to March, women were heavily involved in post-harvest activities of rice and other field crops. Women spend 2.7 hours (161 minutes) on cooking, an hour on caring for others (54 minutes), and in total, 8 hours (494 minutes) in reproductive work (which also include shopping and getting services). Very few women reported to have worked in farming or fishing, with an average of only 5 minutes. The reason for the low reporting of this activity is because it excludes off-farm activities (which is included in domestic work activity), and livestock rearing (which is assigned under owning a business). Women spend about half an hour on working as an employee, owner of a business, in textiles, or livestock-raising.

Table 1: Summary Statistics for Bangladesh

Child outcomes and characteristics (6-23 months)	**Obs**	**Mean**	**Standard Deviation**	**Min**	**Max**
Minimum acceptable diet (=1, 0 otherwise)					
Boys	245	0.20	0.40	0	1
Girls	241	0.19	0.39	0	1
All	486	0.20	0.40	0	1
Minimum dietary diversity (=1, 0 otherwise)					
Boys	245	0.35	0.48	0	1
Girls	240	0.33	0.47	0	1
All	485	0.34	0.47	0	1
Mother's years of education	486	4.34	3.57	0	17
Age in months	486	14.12	4.63	6	23
Girl (=1, 0 otherwise)	486	0.50	0.50	0	1
Women's outcomes and characteristics					
Women's dietary diversity (0-9)	3,466	3.97	1.22	0	9
Household head's age	3,466	40.57	10.26	20	95
Household head's years of education	3,466	3.29	3.94	0	17
Age of woman	3,466	32.51	8.15	18	49
Currently pregnant (=1, 0 otherwise)	3,466	0.05	0.22	0	1
Lactating	3,466	0.24	0.43	0	1
Women's years of education	3,466	3.48	3.53	0	17
Hindu household (=1, 0 otherwise)	3,466	0.12	0.32	0	1
ln (household size + 0.1)	3,466	1.47	0.31	1	3
Household size	3,466	4.47	1.45	2	16
Girl age 0-2 in household (=1, 0 otherwise)	3,466	0.15	0.35	0	1
Boy age 0-2 In household (=1, 0 otherwise)	3,466	0.15	0.36	0	1
Girl age 2-4 In household (=1, 0 otherwise)	3,466	0.11	0.32	0	1
Boy age 2-4 In household (=1, 0 otherwise)	3,466	0.11	0.31	0	1
Women age 5-10 in household (=1, 0 otherwise)	3,466	0.33	0.47	0	1
Women age 11-18 in household (=1, 0 otherwise)	3,466	0.29	0.45	0	1
Men age 5-10 in household (=1, 0 otherwise)	3,466	0.35	0.48	0	1
Men age 11-18 in household (=1, 0 otherwise)	3,466	0.29	0.45	0	1
Dependency ratio	3,466	0.81	0.58	0	5
Household owns large livestock	3,466	0.47	0.50	0	1
Household owns small livestock	3,466	0.22	0.41	0	1
Male-female difference in asset ownership	3,466	3.12	2.40	-4	11
Male - female education gap	3,466	-0.18	3.36	-12	15
Male- female age gap	3,466	8.08	4.82	-7	47
Main source of drinking water is piped, tube or protect well (=1, 0 otherwise)	3,466	0.19	0.40	0	1
Main toilet is kutcha, sanitary with flush and without flush (=1, 0 otherwise)	3,466	0.48	0.50	0	1
Household has access to electricity (=1, 0 otherwise)	3,466	0.46	0.50	0	1
Household owns means of transport (=1, 0 otherwise)	3,466	0.35	0.48	0	1
Non-agricultural asset index	3,466	-0.04	0.95	-1	3
Log of cultivable/arable land size owned (plus 0.0001)	3,466	-5.61	4.31	-9	3

Household head is agricultural day labor (=1, 0 otherwise)	3,466	0.16	0.36	0	1
Household head is trader (=1, 0 otherwise)	3,466	0.14	0.35	0	1
Household head is sharecropper (=1, 0 otherwise)	3,466	0.14	0.35	0	1
In last 12 months, female respondent engaged in:					
Food crop	3,466	0.42	0.49	0	1
Cash crop	3,466	0.30	0.46	0	1
Livestock raising	3,466	0.56	0.50	0	1
Fishing or fishpond culture	3,466	0.07	0.26	0	1
Food or cash crop or livestock raising	3,466	0.68	0.47	0	1
Wage work	3,466	0.30	0.46	0	1
Non-farm economic activities	3,466	0.27	0.44	0	1
In last 12 months, male respondent engaged in:					
Food crop	3,466	0.58	0.49	0	1
Cash crop	3,466	0.37	0.48	0	1
Livestock raising	3,466	0.56	0.50	0	1
Fishing or fishpond culture	3,466	0.15	0.36	0	1
Food or cash crop or livestock raising	3,466	0.74	0.44	0	1
Wage work	3,466	0.54	0.50	0	1
Non-farm economic activities	3,466	0.50	0.50	0	1
Women's time use in activities last 24 hours (in minutes)	***Obs***	***Mean***	***Standard Deviation***	***Min***	***Max***
Reproductive work and off-farm activities	**3,466**	**494.08**	**141.31**	**0**	**900**
Domestic work and off-farm activities	3,466	278.66	125.75	0	720
Cooking	3,466	160.57	74.38	0	570
Care for children/adults/elderly	3,466	54.03	81.28	0	570
Productive work	**3,466**	**33.77**	**100.10**	**0**	**720**
Farming and fishing	3,466	5.13	40.96	0	630
Working as employed, owner of business, construction, weaving, textile, sewing (including livestock raising)	3,466	28.45	92.17	0	720
Leave out means of women's time use in community in:					
Reproductive work and off-farm activities	3,466	474.00	59.00	312	688
Domestic work and off-farm activities	3,466	270.59	55.91	135	508
Cooking	3,466	154.25	26.44	75	246
Care of others	3,466	48.07	26.15	0	145
Productive work	3,466	33.99	33.90	0	272

Ghana

In Ghana, the survey interviewed 4,410 households in the four Northern regions of Brong Ahafo, Northern, Upper East and Upper West regions.[4] For women's age group of 15-49, there are 2,025 women with time use information and a male respondent, but we focus our analysis to respondents whose female respondents' total time recorded is less than or equal to 1440 minutes (i.e. 24 hours) and greater than 1000 minutes. This causes

[4] USAID's ZOI includes the three regions of Northern, Upper East and Upper West regions. Areas above the 8th degree parallel in Brong Ahafo region are included in the survey.

about 30 percent sample attrition because the total time spent recorded was either over 1440 minutes or below 1000 minutes, making the size of our final sample to be 1,390 households.

Table 2 presents the summary statistics for Ghana. 21 percent of households are located in urban areas, and 45 percent of households identify Islam as their main religion. Women on average consume 4.0 out of 9 food groups. Only 10 percent of women can read and write in any language, compared to the household heads' literacy rate of 23 percent. A third of children (aged 6 – 23 months) have minimum dietary diversity, but only 16 percent have minimum acceptable diets. Our sample shows that girls have substantially better nutrition than boys in both indicators.

Most respondents (82 percent of women and 90 percent of men) have engaged in food crop farming in the last 12 months. Considerable number of respondents (40 percent of women and 28 percent of men) were involved in non-farm economic activities (such as self-employment, small business) in the past year, but there was limited engagement in wage work (6 percent of women and 11 percent of men).

Women spend about 4.8 hours (285 minutes) on reproductive work, of which they allocate about 2 hours each to cooking (130 minutes) and domestic work (112 minutes). But their care time is much less at about 35 minutes on average. It is possible that time in caring for others is undertaken concurrently with other activities and respondents did not identify them as a primary activity.[5] Women also spend considerable time in farming, livestock raising and fishing at about 3.7 hours (222 minutes), while they spend just over an hour as an employee, owner of a business or weaving/sewing/textile care (74 minutes).

Table 2: Summary Statistics for Ghana

	Obs	Mean	Standard Deviation	Min	Max
Child outcomes and characteristics (6-23 months)					
Minimum acceptable diet (=1, 0 otherwise)					
Boys	117	0.10	0.30	0	1
Girls	139	0.22	0.41	0	1
All	256	0.16	0.37	0	1
Minimum dietary diversity (=1, 0 otherwise)					
Boys	117	0.28	0.45	0	1
Girls	139	0.40	0.49	0	1
All	256	0.35	0.48	0	1
Girl (=1, 0 otherwise)	256	0.54	0.50	0	1
Child's age in months	256	13.36	4.59	6	23
Mother can read and write (=1, 0 otherwise)	256	0.10	0.30	0	1
Women's outcomes and characteristics					
Women's dietary diversity (0-9)	1,390	3.98	1.61	0	9
Household head's age in years	1,390	40.54	12.44	18	100

[5] However, most respondents did not identify caring for others as a secondary activity. This is most likely to due to the low reporting on secondary activity, and not because they did not watch children while carrying out another task.

Household head can read and write (=1, 0 otherwise)	1,390	0.23	0.42	0	1
Age in years	1,390	31.87	7.77	18	49
Currently pregnant (=1, 0 otherwise)	1,390	0.11	0.31	0	1
Respondent can read and write (=1, 0 otherwise)	1,390	0.10	0.30	0	1
Urban (=1, 0 otherwise)	1,390	0.21	0.41	0	1
Muslim household (=1, 0 otherwise)	1,390	0.45	0.50	0	1
Male-female difference in asset ownership	1,390	5	3	-8	12
Log of (household size + 0.1)	1,390	1.78	0.44	1	4
Household size	1,390	6.44	3.09	2	35
Dependency ratio	1,390	1.17	0.78	0	7
Girl age 0-2 in household (=1, 0 otherwise)	1,390	0.29	0.45	0	1
Boy age 0-2 In household (=1, 0 otherwise)	1,390	0.26	0.44	0	1
Girl age 2-4 In household (=1, 0 otherwise)	1,390	0.23	0.42	0	1
Boy age 2-4 In household (=1, 0 otherwise)	1,390	0.27	0.44	0	1
Women age 5-10 in household (=1, 0 otherwise)	1,390	0.47	0.50	0	1
Women age 11-18 in household (=1, 0 otherwise)	1,390	0.34	0.48	0	1
Men age 5-10 in household (=1, 0 otherwise)	1,390	0.52	0.50	0	1
Men age 11-18 in household (=1, 0 otherwise)	1,390	0.43	0.49	0	1
Main type of toilet is flush (=1, 0 otherwise)	1,390	0.01	0.11	0	1
Main source of drinking water is piped (=1, 0 otherwise)	1,390	0.15	0.36	0	1
If main source of drinking water is tube or protected well (=1, 0 otherwise)	1,390	0.52	0.50	0	1
Household has access to electricity (=1, 0 otherwise)	1,390	0.25	0.43	0	1
Household owns bike, motorcycle, car (=1, 0 otherwise)	1,390	0.86	0.34	0	1
Non-agricultural asset index	1,390	0.07	0.99	-1	3
Household owns large livestock (=1, 0 otherwise)	1,390	0.25	0.43	0	1
Household owns small livestock (=1, 0 otherwise)	1,390	0.67	0.47	0	1
In last 12 months, female respondent engaged in:					
Food crop	1,390	0.82	0.39	0	1
Cash crop	1,390	0.52	0.50	0	1
Livestock raising	1,390	0.45	0.50	0	1
Food or cash crop or livestock raising	1,390	0.85	0.36	0	1
Wage work	1,390	0.06	0.24	0	1
Non-farm economic activities	1,390	0.39	0.49	0	1
In last 12 months, male respondent engaged in:					
Food crop	1,390	0.90	0.30	0	1
Cash crop	1,390	0.59	0.49	0	1
Livestock raising	1,390	0.68	0.47	0	1
Food or cash crop or livestock raising	1,390	0.92	0.27	0	1
Wage work	1,390	0.11	0.31	0	1
Non-farm economic activities	1,390	0.28	0.45	0	1
Women's time use in activities the last 24 hours (in minutes)	***Obs***	***Mean***	***Standard Deviation***	***Min***	***Max***

Reproductive work	**1,390**	**285.46**	**162.04**	**0**	**1,099**
Domestic work	1,390	111.58	106.27	0	795
Cooking	1,390	130.25	77.44	0	620
Care for children/adults/elderly	1,390	35.63	69.71	0	765
Productive work	**1,390**	**296.01**	**207.77**	**0**	**1,290**
Farming, livestock, fishing	1,390	222.06	211.09	0	1,290
Working as employed, owner of business, weaving, textile, sewing	1,390	73.95	167.78	0	1,110
Leave out means of women's time use in community in (in minutes):					
Reproductive work	1,390	271.78	75.80	95.91	495
Productive work	1,390	304.77	112.14	40.33	910
Agriculture	1,390	229.22	140.01	0.00	682
Working as employed, owner of business, weaving, textile, sewing	1,390	74.00	98.00	0.00	545

Nepal

The baseline survey of a USAID project, *Suaahara* was conducted in June-October 2012, and was administered to mothers with children below the age of five, and their husbands, if available (Cunningham et a 2013). The areas covered include 16 districts in three agroecological zones of mountains, hills and *terai*. Our sample consists of 2,173 households with female and male respondents and women between the ages of 15 and 49. On average, female respondents have about 4.4 years of formal schooling.

Table 3 gives the summary statistics for Nepal. Women consume 3.9 groups out of 9. Almost half the children aged 6-23 months (45 percent) have a minimum dietary diversity, while 35 percent of them have a minimum acceptable diet. Our sample shows that girls have a lightly better nutrition than boys.

Most female and male respondents (90% for both) have engaged in food crop farming in the last year, with almost all of them involved in some form of agricultural activity (about 95 percent of women and men). A significant proportion of respondents (about 85 percent of women and men) participated in livestock-raising, and about half were involved in poultry farming. This is related to the fact that 82 percent of households own large livestock (such as oxen or cattle) and 76 percent own small livestock (such as goats, pigs or sheep). There is considerable level of engagement in wage work (19 percent of women and 48 percent of men), but there is limited participation in non-farm economic activities (13 percent of women and 27 percent of men).

Unlike the other two countries, time spent in domestic work for Nepal includes cooking, getting services, shopping, weaving and sewing. For this activity, women allocate 4.2 hours (250 minutes). They spend 2.4 hours (141 minutes) in caring for others, and in total, 6.5 hours (391 minutes) in reproductive work. Most of the time spent in productive work comes from engaging in agriculture (farming/fishing/livestock) at 4

hours (243 minutes) a day. On average, only 24 minutes is spent in working as employed or as an owner of a business.

Table 3: Summary Statistics for Nepal

	Obs	Mean	Standard Deviation	Min	Max
Minimum acceptable diet (=1, 0 otherwise)					
Boys	391	0.32	0.47	0	1
Girls	376	0.38	0.48	0	1
All	767	0.35	0.48	0	1
Minimum dietary diversity (=1, 0 otherwise)					
Boys	391	0.42	0.49	0	1
Girls	376	0.47	0.50	0	1
All	767	0.45	0.50	0	1
Age in months	767	14.30	5.10	6	23
Mother's education in years	767	5.05	4.60	0	22
Women's outcomes and characteristics	**Obs**	**Mean**	**Standard Deviation**	**Min**	**Max**
Women's dietary diversity	2,173	3.86	1.09	0	9
Household head's age in years	2,173	45.16	14.86	17	86
Household head's years of education	2,173	4.93	4.73	0	18
Age in years	2,173	27.02	6.33	15	49
Female respondent's years of education	2,173	4.39	4.55	0	22
Currently pregnant (=1, 0 otherwise)	2,173	0.07	0.25	0	1
Lactating	2,173	0.80	0.40	0	1
Log of (household size + 0.1)	2,173	1.79	0.36	1	3
Household size	2,173	6.38	2.49	3	28
Male-female difference in asset ownership	2,173	1.50	2.77	-9	9
Male - female education gap	2,173	2.48	3.81	-11	18
Male- female age gap	2,173	5.02	5.05	-13	41
Main source of drinking water is piped (=1, 0 otherwise)	2,173	0.69	0.46	0	1
If main source of drinking water is tube or protected well (=1, 0 otherwise)	2,173	0.24	0.43	0	1
Main type of toilet is flush	2,173	0.47	0.50	0	1
Household has access to electricity (=1, 0 otherwise)	2,173	0.85	0.36	0	1
Household owns means of transport (=1, 0 otherwise)	2,173	0.26	0.44	0	1
Non-agricultural asset index	2,173	0.05	0.88	-5	1
Mid caste	2,173	0.37	0.48	0	1
Low caste	2,173	0.17	0.38	0	1
Hill	2,173	0.42	0.49	0	1
Mountain	2,173	0.27	0.45	0	1
Dependency ratio	2,173	1.07	0.74	0	6
Girl age 0-2 in household (=1, 0 otherwise)	2,173	0.40	0.49	0	1
Boy age 0-2 In household (=1, 0 otherwise)	2,173	0.41	0.49	0	1
Girl age 2-4 In household (=1, 0 otherwise)	2,173	0.24	0.43	0	1
Boy age 2-4 In household (=1, 0 otherwise)	2,173	0.25	0.43	0	1
Women age 5-10 in household (=1, 0 otherwise)	2,173	0.37	0.48	0	1

Women age 11-18 in household (=1, 0 otherwise)	2,173	0.36	0.48	0	1
Men age 5-10 in household (=1, 0 otherwise)	2,173	0.32	0.47	0	1
Men age 11-18 in household (=1, 0 otherwise)	2,173	0.26	0.44	0	1
In last 12 months, female respondent engaged in:					
Food crop	2,173	0.90	0.31	0	1
Cash crop	2,173	0.53	0.50	0	1
Livestock raising	2,173	0.87	0.33	0	1
Poultry	2,173	0.53	0.50	0	1
Fishing	2,173	0.02	0.15	0	1
Food or cash crop, livestock, poultry or fishing	2,173	0.95	0.21	0	1
Wage work	2,173	0.19	0.39	0	1
Non-farm economic activities	2,173	0.13	0.33	0	1
In last 12 months, male respondent engaged in:					
Food crop	2,173	0.90	0.30	0	1
Cash crop	2,173	0.49	0.50	0	1
Livestock raising	2,173	0.85	0.36	0	1
Poultry	2,173	0.49	0.50	0	1
Fishing	2,173	0.06	0.25	0	1
Food or cash crop, livestock, poultry or fishing	2,173	0.94	0.23	0	1
Wage work	2,173	0.48	0.50	0	1
Non-farm economic activities	2,173	0.27	0.45	0	1
Women's time use in activities the previous day (in minutes)					
Reproductive work	**2,173**	**391.21**	**183.14**	**0**	**1,135**
Domestic work and cooking (including shopping, getting services, weaving/sewing)	2,173	250.06	138.47	0	1,070
Care of others	2,173	141.15	117.11	0	840
Productive work	**2,173**	**266.50**	**217.94**	**0**	**925**
Farming, livestock, fishing	2,173	242.73	216.88	0	925
Working as employed, owner of business	2,173	23.76	96.52	0	790
Leave out means of women's time use in community in (minutes):					
Reproductive work	2,173	386.45	85.22	192	703
Domestic work and cooking	2,173	247.36	57.38	108	572
Caring for others	2,173	139.09	47.56	12	289
Productive work	2,173	267.40	123.86	6	601
Agriculture	2,173	247.72	129.58	0	601

4. Empirical methodology

The challenge in examining the impact of women's time use on nutrition is that there could be unobserved characteristics, such as a woman's preference or ability to cook or care for her child that influence her time allocation that also impact nutrition (Glick 2002). For example, a woman who likes to cook may spend more time cooking, could

also end up producing a more diet-diverse meal. Assessing the impact of cooking time on dietary diversity without taking into account of the endogeneity of time would overstate the impact of time. Alternatively, a woman who is an efficient cook might be able to produce a diverse meal in a short amount of time. This would lead to an underestimation of the impact of time on dietary diversity. Hence, in the case of cooking time, the direction of the bias is not clear. Therefore, we use an instrumental variables technique to take into account of endogeneity of time use. The instruments are discussed in section 4.2 (ii).

The first outcome we study is women's dietary diversity. Given the possible endogeneity of time, we use a Two Stage Least Squares (2SLS) by first estimating the log of women's time spent in activity *j,* and in the second stage, assessing the impact of women's time use on an activity *j* on women's dietary diversity. The results from the 2SLS model will be compared to estimates from an Ordinary Least Squares (OLS) model. The following equation (1) is estimated:

$$\boldsymbol{N} = \beta_0 + \beta_1\, log(time\ use)_j + \beta_2 \boldsymbol{I} + \beta_3\, \boldsymbol{H} + u \qquad (1)$$

where $\boldsymbol{N}$ is a vector of women's dietary diversity in the previous day, β_i are parameters to be estimated, *log*(*time use*$_j$*)* is the log of time spent in activity *j* the last 24 hours (measured in log of minutes plus 1), $\boldsymbol{I}$ is a vector of individual characteristics, $\boldsymbol{H}$ is a vector of household characteristics, and *u* is the error term. Time allocation is aggregated into seven activity groups for reproductive and productive work that will be discussed in section 4.2 (i).

The second and third outcomes we study are whether a child aged 6-23 months has a minimum dietary diversity and minimum acceptable diet in the past 24 hours. Because these are binary outcomes, we use a IV probit model with the first stage estimating women's time allocation, and in the second stage, we evaluate the impact of time on nutrition. The marginal effects from the IV probit estimation will be compared to marginal effects from a probit model. Because we are interested in analyzing the impact of maternal time on child nutrition, the sample is restricted to cases where the female respondent is the mother.

4.1 Outcome variables

This section provides a definition of the outcomes used in the analysis.

(i) Women's dietary diversity

Women's dietary diversity is defined by the number of food groups (out of nine groups) female respondents consumed in the past 24 hours. The food groups include: 1)

starchy staples; 2) green leafy vegetables; 3) other vitamin A rich fruits and vegetables; 4) other fruits and vegetables; 5) organ meat; 6) meat and fish; 7) eggs; 8) legumes and nuts; 9) milk and milk products (Kennedy, Ballard and Dop 2011). Individual level dietary diversity scores for women and children have shown that they have a positive correlation with micronutrient adequacy of the diet (Arimond et al, 2010).

(ii) IYCF minimum diet diversity (>=4)

Minimum diet diversity is achieved when a child aged 6-23 months has consumed at least four food groups during the previous day (WHO 2008). **Sophie to add precise definition – Infant and young child feeding practices**

(iii) IYCF minimum acceptable diet

Minimum acceptable diet is achieved when a child 6 – 23 months who had a minimum dietary diversity and minimum meal frequency in the last 24 hours.). **Sophie to add precise definition**

4.2 Independent variables

(i) Time Use

The time use module in each survey is administered to respondents using a 24 hours recall. The surveys ask how the respondent spent the previous day using the following categories: sleeping; eating and drinking; personal care; school; work as employed; own business; farming/livestock/fishing; shopping/getting services (including access to health services); weaving, sewing and textile care; cooking; domestic work (including fetching water and wood); care for children/adults/elderly; traveling and commuting; watching TV/listening to radio/reading; exercising; social activities and hobbies; religious activities; and others. The survey in Nepal has a slightly different categorization of activities. For example, time spent cooking and domestic work is combined, and this category includes weaving and textile care. The Bangladesh BIHS includes a category on construction, and the agriculture is only restricted to farming and fishing, and livestock is included in owning a business.

Because the extent to which women's time in reproductive or productive work influence nutrition likely depends on the type of activities involved, our analysis aggregates time allocation into seven activity groups as shown in Table 4.

Table 4: 7 Activity Groups of Women's Time Use for Reproductive and Productive Work

1. Reproductive work	**5. Productive work**
Sum of cooking, domestic work (including fetching	Sum of agriculture, working as employed, owner of

water and wood), care for others and shopping and getting services	a business and weaving/textile/sewing[6]
2. Domestic work, including fetching water and wood	**6. Agricultural work** Sum of farming, livestock or fishing
3. Cooking	**7. Non-agricultural work** Sum of working as employed, owner of a business or weaving/textile/sewing
4. Caring for children, adults or elderly	

Reproductive work is the sum of activities related to cooking, domestic work, caring, shopping and getting services. In addition, we assess the impact of time in domestic work, cooking and caring separately on nutrition. In all countries, the sample size for time spent shopping and getting services is too small, so this activity is not evaluated on its own. Productive work is the sum of agricultural work (in farming, livestock or fishing), working as employed, owner of a business and working in weaving, textile or sewing. For Bangladesh, working in construction is also included in this category. We define non-agricultural work as time spent as employed, owner of a business and working in weaving, textile or sewing, even though it does not rule out the possibility that someone who had worked as an agricultural laborer might have reported to have worked as employed, rather than in agriculture. In addition, time spent in agriculture and non-agricultural work on nutrition are assessed separately. There are small variations to the activity types depending on the country as discussed in section 2.

(ii) Instruments

Because of the endogeneity of time use, two types of variables are used as instruments. Firstly, a woman's time allocation could be influenced by the social norms in their village. Studies have shown that gender norms dictate the types of economic activities women engage in, or the level of involvement in activities (Balagamwala et al 2015, Kevane and Wydick 2001, **other sources**). Social norms also affect the degree of involvement in reproductive work by women and men (Bittman X, Akerlof X, **others**). For example, a woman may feel compelled to spend more time in agricultural work if she sees other women in the village engaged in these activities. Similarly, a woman may be obliged to spend a significant amount of time in domestic tasks because women in the village are equally burdened with these chores. In this study, social norms can be measured by the leave out means of women's time spent in productive work or reproductive work in the village as it is exogenous to the woman's time, but it does not directly affect nutrition in that particular household. The leave out means for women's time in reproductive work (or cooking or care) is included as instruments in the first stage of regressions measuring reproductive work (or cooking or care), while leave out means

[6] Nepal has a category for time spent in construction, and we include this in productive work.

for time in productive work is an instrument in the first stage regressions estimating productive work.

Secondly, we expect gender power relations in the household to influence women's empowerment, through her women's allocation of time (**cite source**). Indicators that are proxies for gender bargaining such as the primary male and female age gap, educational gap and gender asset ownership likely affect women's decision-making power in the household but they do not independently affect nutrition (Sraboni *et al.,* 2014).

(iii) Other Control Variables

Individual characteristics contained in vector *I* in equation (1) to estimate women's dietary diversity include the respondent's age, years of education[7] and whether the respondent is pregnant or lactating. For household characteristics in vector *H,* we control for the household size, household head's age, schooling and occupation.[8] The following five variables measure the households' socio-economic status, and have important implications on women's time allocation as they could save time in carrying out domestic chores: a dummy for whether a household has electricity; a dummy for whether the main source of drinking water is piped; a dummy for whether the main source of drinking water is tube well or a protected well; a dummy for whether the toilet is flush, and a dummy for whether the household owns a bike, motorcycle or car. In addition, we construct an asset index using non-agricultural assets such as whether the household owns a house or structures, land not for agricultural purposes, large consumer goods, or non-farm business equipment. The size of cultivable land is in the analysis for Bangladesh, and a dummy for owning agricultural land is included for Ghana and Nepal. Ownership of livestock is likely to improve nutrition by allowing households to have access to meat, eggs and milk. Therefore, dummy variables for owning a large livestock or small livestock are included.

Household composition has implications on women's reproductive work because the presence of young children would require more of their time, while older children, especially girls could substitute their household responsibilities. Hence, dummy variables indicating whether a child in age intervals 0-2, 2-4, 5-10 and 11-18 lives in the household, and this is disaggregated by sex of the child. In addition, we include the household dependency ratio defined as the proportion of household members aged 0-14 and 65 and above over the household members between the age of 15 and 64.

Location specific dummy variables are included such as division dummies for Bangladesh (Barisal, Chittagon, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet), region

[7] In the case of Ghana, we use whether the respondent is literate instead of years of education because there are considerable amount of missing information on educational attainment.

[8] For Ghana and Nepal, since the household head's occupation is missing from the questionnaire, we use proxy variables which asks whether the male respondent participated in producing food crop, cash work, livestock raising, fishing, non-farm economic activities or wage work in the past 12 months.

dummies for Ghana (Brong Ahafo, Northern, Upper East and Upper West) and area dummies for Nepal (mountain, hill and terai). In addition, we control for the household's religion by including a dummy variable for whether a household is Hindi is included for Bangladesh, and whether a household is Muslim for Ghana. For Nepal, we include dummy variables for low caste and mid-caste households.

5. Results

5.1 Bangladesh

(i) Women's Dietary Diversity

Table 5 presents the first stage of 2SLS estimating women's time allocation in seven different activity groupings in each column in Bangladesh. The proxies for social norms, namely the leave out means for time in reproductive work or productive work in the community, are significant at 1 percent in all seven equations indicating that women's time in activities are affected by how others spend their time. In terms of gender gaps, we find that the less empowered women are, proxied by a larger male-female difference in asset ownership and education, the longer women spend in reproductive work, domestic work and off-farm activities. Conversely, the more empowered they are, the longer they spend in productive work and non-agricultural work. This may be because women who are empowered face less social seclusion and have the ability to leave the home and engage in non-agricultural work. Gender gap variables have little effect on time spent in cooking, caring and farming and fishing, however.

[Table 5 here]

Women in households with large or small livestock spend longer in reproductive and domestic work and off-farm activities, although it does not affect time in productive work.

Women's education has a positive effect on women's time in reproductive and domestic work and non-farm activities, while it has a negative effect on time spent in productive work and non-agricultural work. This contradicts human capital theory because as women are more educated, their opportunity of time should rise, predicting an increase in women's labor force participation (Becker [date]). However, this result could be unique to the Bangladesh context where wealthier women spend less time in productive work, and more time in reproductive work. Poorer women have no choice but to engage in productive work (Jain 2015). Having piped, tube or protected well as the main source of drinking water increases time spent in reproductive work suggesting that

the wealth effect of wealthier women spending more time in reproductive work outweighs the time saving effect of water accessibility.

As expected, household composition impacts how women spend their time. Having small children increases women's time in reproductive and care work, although it reduces cooking time. Higher dependency ratio is associated with more time cooking and caring since a higher proportion of young children or elderly increases women's house chore responsibilities. There is evidence that younger girls substitute women's care work as the presence of girls between the ages of 11 – 18 reduces women's time in caring for others.

Table 6 presents the estimates of the Ordinary Least Square (OLS) and 2SLS regressions of the impact of time use on women's dietary diversity in Bangladesh. The IV diagnostics are presented at the bottom of the tables. The endogeneity tests of the 2SLS regressions reveal that the endogenous variables are not endogenous for all equations. Therefore, we can treat the time variables as exogenous and the preferred model is the OLS regressions over the 2SLS.

Our results indicate that women's time spent cooking and caring increase their own dietary diversity. A 100 percent increase in women's time cooking and caring of others improves their own dietary diversity score by 0.045 and 0.018, respectively from the OLS regressions (columns 5 and 7). This implies that women who cook longer have a better dietary outcome for themselves. Conversely, women who engage in non-agricultural work have worse nutrition. A 100 percent increase in time in productive work and non-agricultural work reduce dietary diversity score by 0.017 from the OLS regressions in columns 9 and 13, respectively. Time spent in fishing and farming does not affect their dietary diversity. However, it should be noted that the proportion of respondents who reported time in this activity is small.

Households' wealth improves women's dietary diversity as indicated by the positive impact of non-agricultural asset quintiles, size of cultivable land owned, access to electricity and having a sanitary toilet. Women in larger households have a more diverse diet, while women in Hindu households have worse dietary diversity. The household head's occupation significantly influences women's nutrition. Women have better nutrition when the household head is a trader, while they have worse diets when the head is an agricultural day laborer.

(ii) IYCF Minimum dietary diversity and IYCF Minimum acceptable diet

Tables 7 and 8 present the average marginal effects from a Probit and IV Probit models assessing whether a child had a minimum dietary diversity and minimum acceptable diet the previous day, respectively in Bangladesh. The first stage regressions for the IV Probit are available upon request. IV diagnostic tests are carried out by assuming linear equations using IV regressions because the diagnostic tests are not available for non-linear equations (cite Woodridge?). The Wald tests of exogeneity of the

correlation coefficient of the error terms of the two equations suggest the endogenous time use variables are not endogenous, and therefore the Probit estimations are preferred over the IV Probit models for all equations.

[Tables 7 and 8 here]

The results show that none of mother's time use has any influence on whether the child had a minimum dietary diversity or minimum acceptable diet. Therefore, taken together with the results on the mother's dietary diversity, it shows that while the mother's time allocation impacts her own nutrition, it has no effect on the child' nutrition.

Tables 9 provide a summary of findings from Bangladesh. When we find a positive (negative) impact of time spent in an activity on nutrition, a plus (minus) sign is recorded, and a zero is recorded when there is no impact. Estimations from the preferred regression models (OLS versus 2SLS, or Probit versus IV Probit) based on the IV diagnostic tests are recorded in these tables. When the frequency of respondents who recorded time spent in a particular activity, "small sample" is mentioned in the tables.

Table 9: Bangladesh: Impact of time use on maternal and child nutrition

	Women's Dietary Diversity	**IYCF Minimum Dietary Diversity (6-23 months old)**	**IYCF Minimum Acceptable Diet (6-23 months old)**
Reproductive work	0	0	0
Domestic work and off-farm activities	0	0	0
Cooking	+	0	0
Care for child/adult/elderly	+	0	0
Productive work	-	0	0
Farming and fishing	Small sample	Small sample	Small sample
Employed, owning business, weaving, livestock	-	0	0

Source: Authors' calculations

5.2 Ghana

(i) Women's Dietary Diversity

Table 10 presents the results from the first stage of the 2SLS estimating women's time allocation in Ghana. Social norms affect women's time allocation since the leave out means for time spent in each activity in their community are significant at 1 percent in all equations. A larger male-female asset ownership gap is positively associated with time in reproductive work and cooking, consistent with results from Bangladesh.

[Table 10 here]

Women in urban areas spend less time in domestic work, while they spend more time working in non-agricultural work. As expected, presence of young children increases women's time in reproductive and care work. The larger the household, the less time the woman spends in reproductive work suggesting some level of substitution of domestic chores by other household members. Further, the presence of girls aged 11-18 reduces women's cooking time suggesting that young girls step in to take care of cooking. Women who are literate spend less time in care work. Household head's literacy does not seem to affect women's time allocation.

Table 11 provides the results from the OLS and 2SLS estimations on the effect of women's time on women's dietary diversity in Ghana. The tests of endogeneity imply that time use variables for reproductive work, domestic work, cooking, caring and non-agriculture are in fact exogenous. Therefore, the OLS regression is the preferred model for these equations. For time in productive work and agriculture, the IV diagnostic tests suggest that the 2SLS regressions are preferred over the OLS. For these, the over-identification and under-identification tests imply that the instruments are valid and the system is identified. The Kleibergen-Paap Wald F-statistic for the estimation of time allocated to agriculture of 20.6 (in column 12) exceeds the Stock-Yogo critical value for 10 percent maximal IV size, while the F statistic in estimating time in productive work of 14.0 (in column 10) only exceeds the critical value for 15 percent maximal IV size suggesting that the instrument may be weak.

[Table 11 here]

The results indicate that while women's time in reproductive work do not impact their own dietary diversity, time in productive work and agriculture has a negative effect. A 100 percent increase in productive work and agriculture reduces their dietary diversity by 0.27 and 0.39 from the 2SLS (columns 10 and 12), respectively.

Women who are literate have a more diverse diet. Women with male respondents who have engaged in livestock-raising have a better dietary diversity due to having access to livestock, but owning livestock does not affect their diet. As expected, greater socio-economic status and living in an urban area is associated with better dietary diversity, as highlighted by the positive effect of asset indices, the household having access to electricity and owning means of transport.

(ii) IYCF Minimum dietary diversity (MDD) and IYCF Minimum acceptable diet (MAD)

Tables 12 and 13 show the average marginal effects of mother's time on whether the child had a minimum dietary diversity and minimum acceptable diet from a probit and IV

probit estimations in Ghana. The first stage regresions for the IV probits are available upon request. The IV diagnostic tests suggest that mother's time allocated to domestic work, cooking care and agriculture are endogenous, but the Kleibergen-Paap Wald F statistics suggest that the instruments may be weak, and the null hypothesis that the system is under-identified cannot be rejected at 5 percent. Therefore, the preferred results are the probit models.

[Tables 12 and 13 here]

Mother's time in domestic work increases the probability that a child has better nutrition. A 100 percent increase in domestic work raises the probability of MDD by 5.4 percent (equation 3 in Table 12) and MAD by 10 percent (equation 3 in Table 13). In contrast to the women's dietary diversity, mother's time in productive work also increases child nutrition. A 100 percent increase in productive work raises the probability of MDD by 2.5 percent (equation 9 in Table 12) and MAD by 3.2 percent (equation 9 in Table 13). This suggests that while working in productive work or agriculture has a detrimental effect on their own nutrition, it could increase the types of available food or income for their children.

Table 14 summarizes the results for Ghana.

Table 14: Ghana: Impact of time use on maternal and child nutrition

	Women's Dietary Diversity	**IYCF Minimum Dietary Diversity (6-23 months old)**	**IYCF Minimum Acceptable Diet (6-23 months old)**
Reproductive work	0	0	+
Domestic work	0	+	+
Cooking	0	0	0
Care for child/adult/elderly	0	0	0
Productive work	-	+	+
Agriculture	-	0	0
Non-agriculture	Small sample	Small sample	Small sample

Source: Authors' calculations

5.3 Nepal

(i) Women's Dietary Diversity

Table 15 presents the first stage of 2SLS estimating women's time allocation in seven activity groupings in Nepal. Social norms, proxied by the leave out means of women's time in reproductive or productive work significantly affect women's time allocation at 1 percent for all equations, except for time spent working as employed, owners of a

business or in textiles. The fact that this instrument is not significant is most likely because only 7 percent of women reported having spent time in this activity. In terms of gender gaps, the more empowered women are, proxied by a larger male-female asset gap, the less women spend time in reproductive work. Other gender gap measures are not significant.

[Table 15 here]

As expected, having young children (aged 0-2) in the house is associated with more time in reproductive and care work, and less time in productive and agricultural work. Having access to electricity and means of transport reduces women's time spent in productive and agriculture. Male respondents' occupations have an effect on women's time allocation. Women in households where the male respondents engaged in nonfarm economic activities in last 12 months spend more time in reproductive, domestic work and cooking, while they spend less time in agriculture. This suggests that women are more heavily involved in reproductive work when men bring in income.

Table 16 presents the marginal effects from the OLS and 2SLS of the effects of time use on women's dietary diversity. The endogeneity tests imply that the time use variables are exogenous. Therefore, the OLS regressions are the preferred models for all equations.

[Table 16 here]

Nepal estimates show that women's time in domestic work and cooking improves her own dietary diversity, similar to the results from Bangladesh. A 100 percent increase in time spent in domestic work and cooking raises her dietary diversity by 0.04. However, time spent in caring for others reduces her dietary diversity (where a 100 percent increase in caring time is associated with a drop in dietary diversity by 0.03). This suggests that women's caring responsibilities have a detrimental effect on their nutrition because they prioritize the care of others over their own nutrition.

Contrary to results from Bangladesh and Ghana, women's time in productive work increases their dietary diversity. This could be because it increases their access to a diversity of food types, and there may have been able to improve their diet through an income effect.

Women in households that own small livestock have a significantly better nutrition because having small livestock gives them diverse source of diet. Women who are more educated and women in households whose heads are more educated have a higher dietary diversity. Wealth improves nutrition as indicated by the positive coefficients on household's access to electricity and better source of drinking water.

(ii) IYCF Minimum dietary diversity (MDD) and IYCF Minimum acceptable diet (MAD)

Tables 17 and 18 present the estimates from a Probit and IV Probit models estimating whether a child has a MDD and MAD the previous day, respectively in Nepal. For equations estimating MDD, the Wald tests of exogeneity imply that the time use variables are exogenous. But for the equations estimating MAD, the Wald tests of exogeneity imply that they are in fact endogenous. However, for reproductive work, domestic work and cooking in estimating MAD, the Hansen J-statistic tests suggest that the instruments may not be valid, therefore the Probit models are preferred for these activities. For productive work and agriculture, the instruments are valid and the equations are identified. The Kleibergen-Paap Wald F statistic for productive work of 9.6 exceeds the Stock-Yogo critical value for 20 percent maximal IV relative bias, but not the value for 10 percent maximal IV relative bias. For agriculture, the Kleibergen-Paap Wald F statistic for 11.0 exceeds the critical value for 10 percent maximal IV relative bias. Taken together, the IV probit models are preferred for productive work and agriculture, even though the relative bias of productive work may be 20 percent.

[Tables 17 and 18]

The Nepal results show that the mother's time allocation has no effect on whether the child has a minimum dietary diversity. However, mother's time in domestic work and cooking improves the chance that the child has minimum acceptable diversity (where a 100 percent in time raises the probability by 2.6 percent from equation 3 in Table 19). Like women's dietary diversity, mother's time in productive work also improves child nutrition. From a probit model, a 100 percent increase in mother's time allocated to agriculture increases the probability of MAD by 1.5 percent, but the probability of MAD becomes considerably larger by 22.8 percent (from equation 9 in Table 19) by using a IV probit model. The same is also true for mother's time in agriculture. This suggests that unobservable characteristics that affect time in productive work and agriculture negatively influence child nutrition since the negative bias causes an underestimation of the impact of productive and agricultural time on nutrition. Taken together with the results for women's nutrition, women's time in productive work improves both women's dietary diversity and children's minimum acceptable diet. A summary of the results from Nepal is provided in Table 19.

Table 19: Nepal: Impact of time use on maternal and child nutrition

	Women's Dietary Diversity	**IYCF Minimum Dietary Diversity (6-23 months old)**	**IYCF Minimum Acceptable Diet (6-23 months old)**
Reproductive work	0	0	0

Domestic work and cooking	+	0	+
Care for child/adult/elderly	-	0	0
Productive work	+	0	+
Agriculture	0	0	+
Non-agriculture	Small sample	Small sample	Small sample

Source: Authors' calculations

6. Conclusion

To be completed.

References:

To be completed.