Off-Farm Labor Supply as a Risk-Coping Strategy

-Preliminary Evidence from Household Survey in the Southern Province, Zambia-

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Abstract

This report presents the results of preliminary analyses of household survey data collected for Theme 2 of the RIHN's Resilience Project so that it would convey the idea as to what kind of research output can be expected. From the viewpoint of "resilience", it is very important to investigate how a farm household recovers its consumption from a shock that negatively affects its income and hence reduces its consumption. If the recovery is quick, such a household is considered to be resilient relative to those who have difficulty in recovering consumption level. Theme 2 aims to provide the evidence of the household-level resilience and to examine its determinants based on the survey data of 48 sample households spread over three agro-ecologically distinctive zones in the Southern Province of Zambia, where variable precipitations often cause shocks at farm household level.

It is well known that rural households in Sub-Saharan Africa have adopted a variety of *ex ante* as well as *ex post* risk response strategies so that consumption be smoothed in the presence of various shocks. Household survey of Theme 2 is designed to deal with all the potential strategies at household level. Among them, this report focuses on off-farm economic activities since they are significant sources of household income in the study site.

Time allocation to 6 categories of activity at household level (hours per day per adult) were obtained from weekly interview on household members' daily time use, and then the average time used for each activity and its variance were compared over the three periods in cropping season: planting season (period 1), before harvest season (period 2), and after harvest season (period 3). It is found that significantly longer time is used for agricultural work in period 1 than other periods, while time used for non-agricultural work is significantly longer in period 3 than other periods. Even in period 3, some households do not increase time allocated to non-agricultural work, while the others increase it. As a result, the variance in time allocation to non-agricultural work is significantly larger in period 3 than other periods. These findings may suggest that some (not all) households use non-agricultural work as an *ex post* risk-coping strategy to respond to crop production shock in the previous cropping season. However, the findings are not sufficient to conclude it: it is necessary to separate *ex ante* portion of non-agricultural work from *ex post* portion of non-agricultural work, and to test if *ex post* non-agricultural work actually smoothes consumption. Such robust analyses remain for future studies. The on-going weekly interview of the household survey together with daily precipitation recorded at plot level as well as weekly body measurement of household members will constitute a rich dataset to investigate household-level resilience in variable environment.

1. Introduction

From the viewpoint of "resilience", it is very important to investigate how a farm household recovers its consumption from a shock that negatively affects its income and hence reduces its consumption. If the recovery is quick, such a household is considered to be resilient relative to those who have difficulty in recovering consumption level. Theme 2 of the RIHN's Resilience Project aims to provide the evidence of the household-level resilience and to examine its determinants based on the data collected from sample households in the Southern Province of Zambia, where variable precipitations often cause shocks at farm household level.

It is well known that poor households in developing countries, particularly in Sub-Saharan African countries, adopt various *ex ante* as well as *ex post* strategies in the variable environment, where insurance and credit markets have rarely developed (Dercon, 2005). Those strategies include *ex ante* crop and income diversification, *ex post* off-farm economic activities including temporary migration, assets typically livestock sales, and receiving gifts and remittances. Relative importance among the strategies should depend on household's characteristics as well as socio-ecological environments. Socio-ecological environment determines local off-farm income opportunities such as natural resource collection, off-season gardening (which is considered to be an off-farm activities), gift-receiving from neighbors, and so on, and consequently should affect the choice of strategies. In spite of the adoption of various strategies, consumption cannot be unaffected in the presence of frequent shocks (Dercon, 2002). Particularly in the case of covariate shock such as drought, informal risk coping mechanisms that depend on neighbors are not effective because many households within a certain region suffer simultaneously, and as a result the reduction of consumption level is not only severer but also more persistent (Hoddinott and Harrower, 2005 and Dercon, Hoddinott, and Woldehanna, 2005). It is still unknown, however, what makes farm households resilient in such cases.

Household survey of Theme 2 is designed to deal with all the strategies mentioned above and to investigate their impact on income/consumption smoothing. Among them, this report focuses on off-farm economic activities since in the study site, the Southern Province of Zambia, they are significant sources of household income. Rose (2001) analyzed off-farm labor supply of agricultural households under rainfall risk in India, and showed that households more relying on rainfall (i.e. with greater risk) were more likely to participate in the labor market (*ex ante* response) and that unexpected low rainfall also increased labor market participation (*ex post* response). As such, Rose's analysis distinguishes *ex ante* and *ex post* off-farm labor supply, but it considers a single labor market outside the farm without making distinction between agricultural employment and non-agricultural employment. On the other hand, Ito and Kurosaki (2006) categorized agricultural household based on the type of work, i.e., self-employment in agriculture, self-employment in non-agriculture, wage work in agriculture, and wage work in non-agriculture, and analyzed labor supply in relation to rainfall risk in India. They showed that rainfall risk increased households' participation in non-agricultural off-farm wage work much more than agricultural off-farm wage work because agricultural wage is negatively affected by the rainfall risk. However, unlike Rose (2001), Ito and Kurosaki (2006) do not distinguish *ex ante* and *ex*

post labor supply. Hence, this report makes the distinction of off-farm labor supply between agriculture and non-agriculture as well as between *ex ante* and *ex post*.

Moreover, in the study site, or in Sub-Saharan Africa in general, labor markets either agricultural or non-agricultural have not developed well, and hence farm households rely almost exclusively on self-employment, which situation is unlike in India where the data used by Rose (2001) and by Ito and Kurosaki (2006) were collected. Because of the relative relevance of non-agricultural self-employment, this report considers natural resource collection and grazing as separate categories from off-farm labor supply. In terms of risk coping, natural resource collection and grazing may have different effects: labor supply to the former activity will have an immediate impact on household consumption as it brings something edible directly back to home, while the latter activity is itself just an asset-keeping and does not generate revenue unless livestock is sold. In addition, if a farm household depends on human networks as risk coping strategies, investment in social capital is also critical (Sakurai, 2006). Since one way to accumulate social capital is to participate in social activities such as church activities, this report regards time spent for social activities as risk-responding labor supply (at least potentially).

2. Study Site and Data

The study site of the Resilience Project Theme 2 is located in "Sinazongwe area" of the Southern Province, Zambia. The Sinazongwe area consists of three distinctive zones in terms of not only agro-ecology but also historical settlement pattern: namely lower slope flat land zone near Kariba lake, middle slope zone, and upper slope flat land zone. We carried out a rapid extensive survey over the three zones, and conducted a group interview in intentionally selected 17 villages to gather village-level information. Out of the 17 villages surveyed, 5 villages representative of the diversity of the study site were chosen. In the lower slope flat land zone, two contrasting adjacent villages were selected: one has been originally located in the current location and the other was relocated to the current location due to the construction of Kariba dam in the 1950's. The two villages together are named site A. In the middle slope zone, most villages were newly established during the 1990's by migrants from the populous lake side zone. Since each village in this zone is relatively small, two adjacent villages were selected to have enough number of population from which we would sample, and were together named site B. As for the upper slope flat land zone an old village that has been receiving immigrants from the lake side zone were selected as site C. Administratively, sites A and B belong to Sinazongwe district, while site C belongs to Choma district.

Then, population census was carried out in July and August 2007 in the three sites. The results of the census are reported in Sakurai (2008a; 2008b). Census information was used for the sample selection so that the sample households are representative of agro-ecological diversity in each site. Based on the census, 16 households in each site, thus 48 households in total were selected. Household survey including weekly interview on household members' time allocation started just before the onset of the rainy season in November 2007. The household survey is still going on at the time when this report is being written in December 2008. Hence, this report

presents only the results of preliminary analyses of household survey data: that is, characteristics of the sample households as of November 2007 and the change of time allocation pattern during the rainy season of 2007/08.

Table 1 Characteristics of Household Heads and Wives as of November 2007[1]

	Site A (Low)	Site B (Middle)	Site C (High)
Male Household Heads			
Number of Spouses per Head	1.31 (0.48)	1.31 (0.48)	1.57 (0.94)
Year of Birth	1969 (13)	1968 (14)	1971 (14)
Number of School Years Completed	6.2 (2.7)	3.4 (3.4)	5.1 (2.9)
Total Number	13	16	14
Female Household Heads			
Number of Spouses per Head	0 (0)	NA	0 (0)
Year of Birth	1946 (4.9)	NA	1963 (8.5)
Number of School Years Completed	2.0 (3.4)	NA	2.0 (2.8)
Total Number	3	0	2
Household Head's Wives			
Year of Birth	1975 (8.1)	1975 (9.4)	1971 (14)
Number of School Years Completed	4.0 (2.2)	2.5 (3.0)	4.2 (2.8)
Total Number	17	21	22

[1] Standard deviations are in the parentheses.

3. Characteristics of Sample Households

Table 1 shows some characteristics of the head and its spouses of sample households. Out of 48 sample households, 43 households are headed by a male. Although most of the farmers in the study site identify themselves as Christian, polygamy is often practiced even by Christians, and hence average number of wives is more than one in each site. Male household heads in site C have more wives than those in other sites, which probably reflects relatively favorable agricultural environment in site C. Average age of male household heads does not differ much among the three sites as shown in the Table 1, but average school years completed are different. While male household heads in site A are relatively more educated, those in site B are relatively less educated on average. This implies that less educated people tend to settle in the escarpment area like site B and/or highly educated farmers may not stay long in the unfavorable area and are likely to move out.

On the other hand, female household heads are either divorced or widowed, and consequently relatively more aged than male household heads on average. In addition, these female heads are less educated. The low human capital endowment among them may be either because they are female or because they are old. If they are compared with the wives of the male household heads, it is confirmed that females are generally less educated than males and that relatively old females are less educated than relatively young females: as shown in Table 1, wives' age on average is the

same or younger than that of their spouses, and wives' education level on average is much lower than that of their spouses. Among the wives, those in site B is the least educated. As discussed above, people that have settled on the slope are not highly educated.

Table 2 Occupations of Male Household Heads (Nov. 2006 – Oct 2007)[1]

Primary Occupation	Secondary Occupation	Site A (Low)	Site B (Middle)	Site C (High)
Agriculture (self)	None	6	6	5
	Agriculture (employed)	1	0	1
	Non-Agri. (self)	4	10	7
	Non-Agri. (employed)	2	0	0
Non-Agri. (self)	None	0	0	0
	Agriculture (self)	0	0	1
	Agriculture (employed)	0	0	0
	Non-Agri. (employed)	0	0	0
Total Number		13	16	14

[1] The figures in the table are the number of male household heads.

Table 2 presents a summary of occupations of male household heads. The information is based on the questions on the primary occupation as well as the secondary occupation of each household heads in terms of time use during the last one year, i.e. from November 2006 to October 2007. As shown in Table 2, the occupations of male household heads are one of agricultural self-employment, employment in agricultural sector, non-agricultural self-employment, and employment in non-agricultural sector, or two of them. Although there are 5 other selections in the questionnaire: domestic work/helping household, student, retired, before schooling age, and not working due to chronically ill, none of them were chosen by male household heads. The results indicate that all the male household heads except one in site C are self-employed in agriculture as the primary occupation, and that 17 of them do not have any secondary occupation, while 21 of them are engaged in non-agricultural self-employment as a secondary occupation. As shown in Table 1 male household heads in site B are the least educated among the three sites, but Table 2 shows that the rate of engagement in non-agricultural self-employment is the highest in site B. It is because they are practicing lumbering thanks to relatively rich timber resources around site B. On the other hand, employment, in either in agricultural sector or non-agricultural sector, is not common among the male household heads in the study site.

In Table 3 female household heads (the number is only 5 as shown in Table 1) and the wives of male household heads are combined together, and their occupations are presented. They are based on the same information as in the case of male household heads. Table 3 indicates that all the females except for three in site C also mention agriculture as their primary occupation. As for their secondary occupation, "no secondary occupation" comes first then domestic work. Unlike

the case of males, non-agricultural self-employment is not so common. Although the distinction between "no secondary occupation" and domestic work is not very clear, it is possible for some females to do little of domestic work since other females such as co-wives, sisters, children are available in the households. Finally, employment is rare among females just like in the case of male household heads.

Table 3 Occupations of Female Household Heads and Head's Wives (Nov. 2006 – Oct 2007)[1]

Primary Occupation	Secondary Occupation	Site A (Low)	Site B (Middle)	Site C (High)
Agriculture (self)	None	12	10	12
	Agriculture (employed)	0	0	0
	Non-Agri. (self)	2	3	4
	Non-Agri. (employed)	0	0	0
	Domestic Work	6	8	5
Domestic Work	None	0	0	0
	Agriculture (self)	0	0	2
	Agriculture (employed)	0	0	1
	Non-Agri. (employed)	0	0	0
	Domestic Work	0	0	0
Total Number		20	21	24

[1] The figures in the table are the number of female household heads and head's wives.

4. Time Allocation

Now the question is how a household allocates its time between sectors, i.e. agriculture and non-agriculture, as well as between periods, i.e. *ex ante* and *ex post*. In order to answer it, household time allocation pattern is calculated from the information obtained by the household weekly interview. The weekly interview asks a one-week recall on daily time use for 7 categories of activity (agriculture, non-agriculture, natural resource collection, grazing, domestic work, social activities, and education) of each household member including children. This question about time use does not distinguish between employment and self-employment in the case of agriculture and non-agriculture, and this report follows such categorization of activities. This cannot be a serious problem since employment is rare in the study site as shown in Tables 2 and 3. Moreover, the weekly interview has another set of questions about the type of work done, which enables us to make a distinction between employment and self-employment although this report does not do it.

Table 4 presents average time allocated to 6 categories of activity for the 16 sample households in site C. Due to time constraints for preparing this report, only site C data are analyzed here. The following remarks on Table 4 need to be noted. First, it limits to adult household members, the definition of which is one whose age is above 12 as of October 2007 when the survey started. By this definition, adult household members include not only the head and its spouses, whose

characteristics are summarized in Tables 1, 2, and 3, but also other adults living in the same household. Some of the adults are students and are going to school. Students above the age of 12 are counted as adults by the definition, but time spent for education (one of the 7 categories as given above) is not included in total work time. Consequently, Table 4 has only 6 categories of activity. As for time period, Table 4 divides one cropping season into three periods so that *ex ante* and *ex post* impact of weather shock can be distinguished. Period 1 is the beginning of 2007/08 cropping season, where ploughing and sowing are the main activities. Period 1 in Table 4 covers 4 weeks from the middle of November to the middle of December in 2007. Period 2 is a pre-harvest period, by which most cropping activities have been completed. Period 2 in Table 4 covers 4 weeks from the middle of February to the middle of March in 2008. Period 3 is the period of after-harvest. Period 3 in Table 4 covers 4 weeks from the middle of April to the middle of May in 2008. Then, for each period and for each household, average time allocated to each category of activity per day per adult is calculated. Finally, the average and the standard deviation of the household-level figures are obtained, and presented in Table 4. Because of some missing data, time allocation is obtained only for 10 households out of 16 in Period 1, and 14 households out of 16 in Periods 2 and 3.

Table 4 Household's Time Allocation among Various Activities (hours per day per adult)[1]

	Period 1 Nov-Dec 2007	Period 2 Feb-Mar 2008	Period 3 April-May 2008
Total Work Time	5.74 (1.41)	4.84 (1.77)	5.39 (1.55)
Agricultural Work	2.28 (0.78)[a]	1.53 (0.77)[a]	1.71 (1.09)
Non-agricultural Work[#]	0.26 (0.21)[a]	0.16 (0.13)[b]	0.88 (0.75)[a, b]
Natural Resource Collection	0.24 (0.16)	0.14 (0.15)	0.18 (0.24)
Grazing[#]	0.23 (0.23)	0.51 (0.49)	0.56 (0.74)
Domestic Work	2.20 (1.27)	2.02 (1.35)	1.62 (0.96)
Social Activities	0.51 (0.41)	0.47 (0.35)	0.48 (0.47)
Number of Households	10	14	14

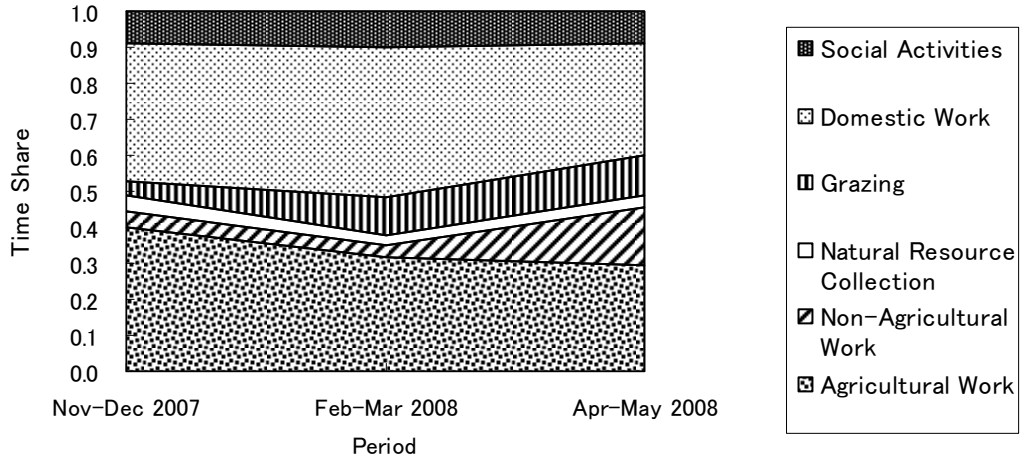
[1] Standard deviations are in the parentheses.
[a] Two averages are different at the significance level of 5% by paired sample T-test.
[b] Two averages are different at the significance level of 1% by paired sample T-test.
[#] The variances of three periods are different at the significance level of 1% by Levene test.

With respect to household time allocation, the following points are salient in Table 4. First, as discussed with Tables 2 and 3, agricultural work uses most of the household work time, but domestic work is almost equally significant in terms of time allocation. Second, since natural resource collection, grazing, and social activities are not considered as occupations, they do not appear in Tables 2 and 3. But they are as important as non-agricultural work in terms of time allocation. Third, as expected, longer time is used for agricultural work in period 1 than other periods. Statistical tests show that difference in the amount of time spent for agriculture is significant between periods 1 and 2. In period 3 there is still agricultural work: some of the

households continue harvesting and post-harvest processing, others work in gardens for vegetable production using residual moisture near streams. Fourth, also as expected, time allocation for non-agricultural work is much larger in period 3 than other periods. The difference is statistically significant between periods 1 and 3 as well as between periods 2 and 3. Fifth, time allocation for other activities also shows some tendency. For example, time used for natural resource collection is the largest in period 1; time spent for grazing is the smallest in period 1; and time for social activities does not change much over the periods. However, the differences in time use for natural resource collection and grazing are not statistically significant, as indicated in Table 4. Sixth, total working time is lower in period 2 where there is not much work for agriculture, although the difference is not statistically significant. If total time per day given to an adult household member is assumed to be 8 hours, the residual of working time can be considered as leisure. And hence, Table 4 indicates that household adult members tend to have more leisure in period 2 than other periods on average.

As discussed above, total working time is variable depending on the period. Hence, instead of absolute hours spent for each activity, Figure 1 shows time share of each activity in total working time. Figure 1 confirms that time share of agricultural work declines over the three periods, while that of non-agricultural work increases in period 3. Figure 1 also shows that time share of domestic work does not change in the first two periods but sharply reduces in period 3. Although this report does not provide rigorous analyses, Figure 1 seems to suggest that non-agricultural work and domestic work are competing for household time in period 3.

Fig. 1 Time Allocation during Cropping Season

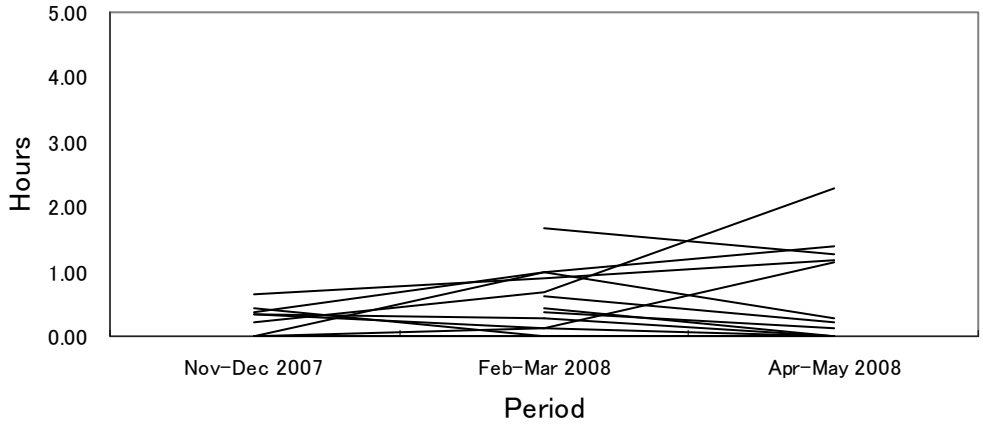


Time allocation pattern differs in each period not only in terms of average time used for each activity but also in terms of variation of time use among sample households. As shown in Table 4, variances are significantly different in the case of non-agricultural work and grazing: variation among households in time use is much larger in period 3 than in other periods. These results can be graphically confirmed in Figures 2 and 3. Each line in the figures corresponds to a sample household. Figure 2 shows that some households do not seem to increase time allocated to

non-agricultural work even in period 3, while the others increase it. In addition, several households sharply increase time allocation to non-agricultural work in period 3, which may create the huge variation in period 3 compared with other periods. This result may suggest that some (not all) households use non-agricultural work as a risk-coping strategy to respond to crop production shock. Figure 3 is for grazing. It shows that some households increase grazing time in period 3, while other households decrease it. Considering that grazing itself does not produce immediate revenue, incremental time allocation to grazing after harvest may not be a risk-coping behavior. The determinants of grazing time remain to be a topic of future research.

Fig. 2 Time Used for Non-Agricultural Work per Day per Adult

Fig. 3 Hours for Grazing per Day per Adult



Figures 4 and 5 are the case where the variances do not significantly differ over the three periods. Figure 4 shows time allocated to agricultural work, indicating that the majority of households reduce time used for agricultural work in period 2, which causes the significant smaller average hours in period 2 than in period 1 as shown in Table 4. Interestingly enough, in period 3, some households increase time allocation to agricultural work, while others decrease it. As a result, the standard deviation increases in period 3 (although statistically not significant), but the

mean value in period 3 does not change significantly. Thus, Figure 4 implies that for some households agriculture in period 3 (i.e. vegetable production in gardens) may be an *ex post* risk coping strategy in the case of crop failure. However, it does not exclude the possibility that the practice of dry season agriculture is determined by other factors such as access to water sources than crop failure in the previous cropping season. Total working time shown in Figure 5, on the other hand, does not show any particular pattern of change over the three periods except for the slight decline in period 2, which is also observed in Table 4. However, looking at each line in Figure 4 reveals that some households increase total working time in period 3, while others decrease it. Thus, it is hypothesized that those who increase total working time in period 3, may be engaged in risk-coping activities, either agriculture or non-agriculture, while those who decrease total working time in period 3, do not necessarily have to conduct any coping in period 3 and hence enjoy leisure. Testing these hypotheses is out of the scope of this report and remains for future research.

Fig. 4 Time Used for Agricultural Work per Day per Adult

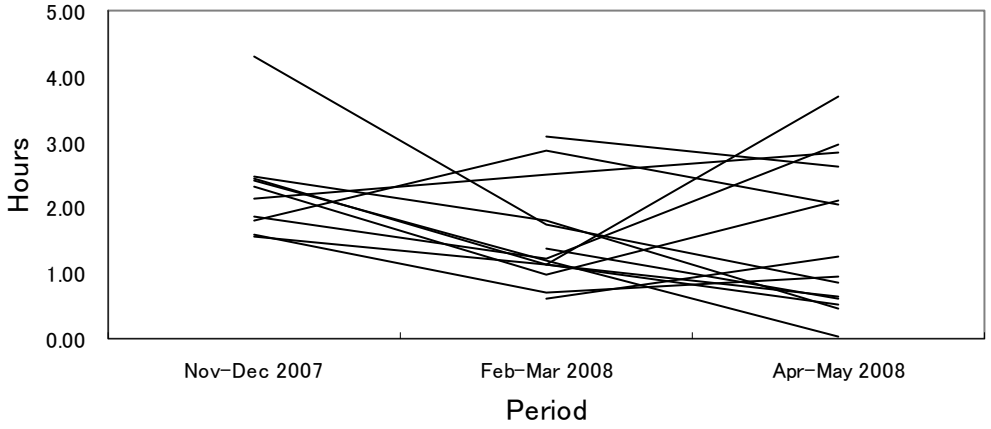
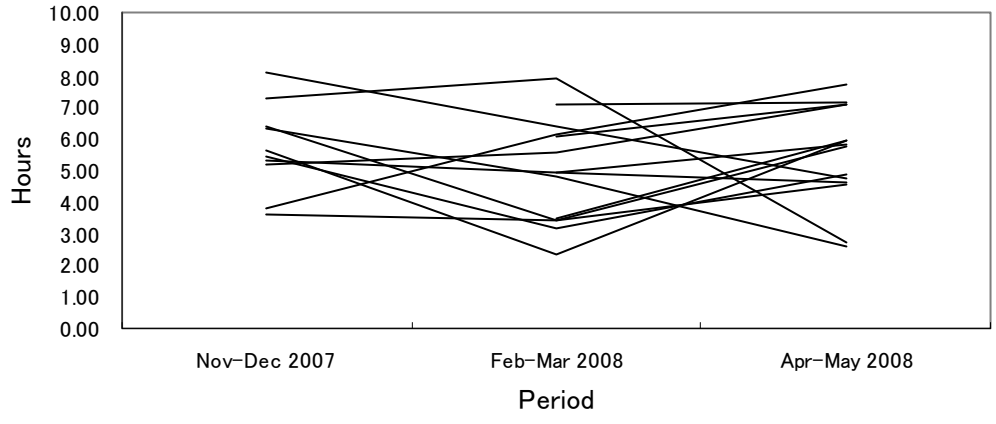


Fig. 5 Total Working Time per Day per Adult



5. Future Direction

Table 4 and Figure 1 in the previous section together indicate that agriculture is the single dominant economic activities during cropping season, while the significance of non-agricultural work increases after harvest. These results might suggest that non-agricultural work is an *ex post* risk coping strategy after having a shock in crop production. However, in order to conclude it, it is necessary to provide evidence that households having suffered a shock in crop production in periods 1 and 2 increase non-agricultural work in period 3. Moreover, it is necessary to separate *ex ante* risk management from *ex post* risk coping, because a household who is vulnerable to external shock such as drought may expect a shock and allocate more time to non-agricultural work as an *ex ante* strategy, which does not depend on crop production performance in previous periods.

The household survey of the Resilience Project Theme 2 makes it possible to investigate these points because it has data of daily precipitation recorded on each sample household's plot and because the survey will continue for at least three years to construct a panel dataset. The former feature of the household survey enables us to deal with rainfall as an idiosyncratic shock because observed rainfall level varies significantly even within a site. Thus, if incremental time allocation to non-agricultural work in period 3 depends on the plot-specific rainfall received in the field, such non-agricultural work can be considered to be an *ex post* coping. But as discussed, cross-sectional comparison using only one season data is not sufficient to separate *ex ante* risk management. With this regard, the latter feature of the household survey will help us to eliminate *ex ante* portion of non-agricultural work because it can be treated as a household fixed effect in panel data.

In this short report, labor supply as risk responses is the only concern. However, as stated in section 1, "resilience" requires consumption smoothing in variable environment. In this sense, it is necessary to test if such labor supply responses really smooth income and hence consumption. The household survey collects weekly information on household's income and consumption. Particularly, as consumption indicators, the survey asks not only the amount of food consumed, but also cash and in-kind expenditures in a week. Moreover, household members' body weight and fat thickness are measured every week. Such a rich dataset is being constructed and remains to be analyzed in future research.

6. Conclusions

Theme 2 of the RIHN's Resilience Project aims to provide the evidence of the household-level resilience and to examine its determinants based on household survey conducted in the Southern Province of Zambia. This report presents only the results of preliminary analyses of household survey data collected during the first cropping season of 2007/08, focusing on labor supply as risk responses. It is found that significantly longer time is used for agricultural work during planting period, while time used for non-agricultural work is significantly longer after harvest. Even in the after harvest period, some households do not increase time allocated to non-agricultural work, while the others increase it. As a result, the variance in time allocation to non-agricultural work is significantly larger after harvest than before harvest. These findings may suggest that some

(not all) households use non-agricultural work as an *ex post* risk-coping strategy to respond to crop production shock in the previous cropping season. However, the findings are not sufficient to conclude it: it is necessary to separate *ex ante* portion of non-agricultural work from *ex post* portion of non-agricultural work, and to test if *ex post* non-agricultural work actually smoothes consumption. Such robust analyses remain for future studies. The on-going weekly interview of the household survey together with daily precipitation recorded at plot level as well as weekly body measurement of household members will constitute a rich dataset to investigate household-level resilience in variable environment.

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