Sample design for 2024 Maldives Labour Force Survey

SAMPLE DESIGN FOR 2024 MALDIVES LABOUR FORCE SURVEY

MALDIVES BUREAU OF STATISTICS (MBS)
Ministry of Finance & Planning

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Developed by:

Maldives Bureau of Statistics

Report Compiled by: By: Alessandro Martini

Report Edited by: Ms. Fathimath Nihan

Layout Design By: Ms. Mushfiqa Ibrahim

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BACKGROUND

In most countries the LFS is the official source of estimates of total employment and unemployment and plays a central role in the national statistical system. The LFS is also one of the main sources of information on socio-demographic characteristics of the working-age population such as age, marital status, level of education and family status. Moreover, the infrastructure used for the LFS (frame, sample, interviewers, processing systems) could support a wide range of other household surveys that are conducted in response to the policy and information needs of government. The estimates must be sufficiently accurate to enable the multiple uses of the data, and the sampling frame must be updated for the LFS to continue fulfilling these essential tasks.

The Maldives Bureau of Statistics (MBS) of the Ministry of Finance and Planning would like to obtain regular labour force and employment indicators through a Labour Force Survey (LFS). The survey is going to begin in 2024, and the feasibility of being continued for the following years will be evaluated.

For Male' it is relevant to get quarterly estimates to get short terms indicators, for the other Atolls annual estimates could be sufficient. There is also interest in obtaining LFS results at the national level for the following administrative island size groups: (1) population of 500 or less; (2) 501 to 1,000 population; (3) 1001 to 2,000 population; (4) 2001 to 5000 population and (5) greater than 5000 population. LFS will cover the resort islands too, the results will be limited to the national level.

Data collection should be spread over all 12 months of the year referring to a specific reference week of the month in order to get reliable and unbiased quarterly data.

The purpose of this report is to define the most effective sample design for the MLD-LFS, the methodology was developed in collaboration with Alessandro Martini ILO consultant, Antonio Discenza ILO, Aishath Shahuda, Deputy Chief Statistician, Fathimath Nihan MBS, Ali Shafeeu MBS and other MBS staff. The Sampling Consultant appreciates their collaboration.

1. SAMPLING FRAME

The sampling frame has been defined according to the 2022 Maldives Population and Housing Census. The sampling frame includes all the population residing in regular households of labour quarters in the administrative and resort islands of each atoll of the Maldives and excludes the institutional population (for example, persons in prisons, hospitals, military barracks and school dormitories).

Atoll	Administrative Islands		Resort Islands		Industrial Islands		Total Population
	Population	%	Population	%	Population	%	
MLE	180,107	100.0	-	0.0	-	0.0	180,107
HA	14,416	95.7	608	4.0	37	0.2	15,061
HDh	21,203	98.6	120	0.6	179	0.8	21,502
Sh	13,566	94.6	584	4.1	195	1.4	14,345
N	12,273	75.3	3,809	23.4	208	1.3	16,290
R	17,377	77.3	4,773	21.2	330	1.5	22,480
B	10,438	65.0	4,949	30.8	662	4.1	16,049
Lh	8,454	71.3	2,868	24.2	541	4.6	11,863
K	15,429	43.2	16,691	46.7	3,614	10.1	35,734
AA	7,785	75.7	2,505	24.3	-	0.0	10,290
Adh	9,847	66.7	4,824	32.7	89	0.6	14,760
V	1,892	73.2	567	21.9	127	4.9	2,586
M	5,354	90.5	326	5.5	236	4.0	5,916
F	4,773	95.4	226	4.5	2	0.0	5,001
Dh	6,248	71.5	2,481	28.4	11	0.1	8,740
Th	9,900	97.5	258	2.5	-	0.0	10,158
L	13,897	95.9	595	4.1	4	0.0	14,496
GA	8,801	85.9	1,434	14.0	15	0.1	10,250
GDh	12,029	95.7	521	4.1	23	0.2	12,573
Gn	8,610	100.0	-	0.0	-	0.0	8,610
S	22,633	98.7	257	1.1	44	0.2	22,934
Total	405,032	88.1	48,396	10.5	6,317	1.4	459,745

Table 1. Distribution of population by atoll and type of island, 2024 LFS Sampling frame

The availability of 2022 census data made it possible to assess the expected sampling errors and the design effects for estimates of the target variables. These results were useful in determining the most effective sampling strategy for the future LFS. The R package R2Beat has been used to determine the sample allocation in the multivariate and multi-domains case of estimates for two-stage stratified samples. It also allows to perform primary stage and second stage units selection. R2BEAT extends the Neyman (1934) – Tschuprow (1923) allocation method to the case of several variables, adopting a generalization of the Bethel's proposal (1989).

Input required by the software refers to:

- mean estimate of the target variables at stratum level
- population variances of the target variables
- intra-class correlation coefficients
- planned coefficient of variation for the estimation domains
- minimum number of interviews (SSUs) in each PSU.

The package provides as output:

- sample size and allocation
- selection PSUs
- selection of SSUs with design weight for both the first and the second stage.

Several attempts were made to define a suitable solution by adjusting the procedure's parameters, including different target variables, varying the minimum number of interviews for each PSU and applying different stratification criteria.

2. SAMPLING DESIGN FOR MALE'

For Male' a quarterly stage stratified sample has been defined. Stratification criterium is based on the "Ward Code" of the 2022 census: 7 Strata.
Primary Sampling Units are "Enumeration Area", included in the 2022 census, for 690 PSUs.
Estimation planned domain is the whole Male which includes 4 wards of Male', Hulhumale' and Villingili (total of the 3 islands).

Target variables considered are:

- employment ratio over the population, with an expected CV=0.04
- potential labor force, with an expected CV=0.10

Unemployment ratio to population has been evaluated as a target variable but the level is quite low in the Maldives, so it defines a very demanding constraint, increasing too much the sample size. Anyway, the unemployment rate is still precise enough to be disseminated, even at quarterly level.

A minimum of 8 SSU in each PSU has been set in order to reduce to reduce the effect of the intra-class correlation on the design effect and increase precision of the target estimates without increasing the sample size.

Stratum	ALLOC	PROP	EQUAL
1001	346	384.8	340.9
1002	298	323.8	340.9
1003	284	313.1	340.9
1004	493	538.6	340.9
1005	81	77.4	340.9
1009	456	408.3	340.9
1012	428	340.0	340.9
Total	2,386	2,386.0	2,386.3

Table 1. Allocation for the Male LFS Quarterly Sample, comparison with proportional an equal allocation

Stratum	PSU	SSU	DELTA	Units
1001	10	80	4.32	345
1002	8	64	4.59	294
1003	8	64	4.41	282
1004	14	112	4.50	504
1005	2	16	4.70	75
1009	12	96	4.75	456
1012	12	96	4.60	442
Total	66	528	4.54	2,398

Table 2. Selection of PSUs for Male LFS Quarterly Sample

For including the individuals residing in the labour quarters definition of SSUs has been reviewed: the variable that identifies the regular households “unit__id” in the labour quarters has the same value for all the resident individuals, so the average size of SSU is quite different for regular household (4.7 individuals) and 11.7 for Labour Quarters, for the whole country. The selection of SSUs in this situation dealt to an unbalanced distribution in the sample, with a too high share of individuals residing in Labour Quarters. For this reason, a new SSU identifier has been defined in the Labour Quarters, with a dimension similar to the average size of Regular Household, at region8 level. In this way the samples drawn are balanced by “unit type”. The same approach has been applied also for the sample design in the other atolls.

In the context of LFS is highly recommended to introduce a rotation scheme in the sampling design to improve the quality of the most relevant indicators produced by the survey. The households in the quarterly sample (grouped in the so-called rotational group) are rotated according a 2-(2)-2 rotation scheme: households are interviewed during two consecutive quarters. Then, after a two-quarters break, they are again interviewed twice in the corresponding two quarters of the following year. As a result, each household is included in four waves of the survey along a 15-month period. The theoretical overlapping is equal to 50% for two consecutive quarterly samples and for same quarters in two consecutive years, it is equal to 25% with a lag of three or five quarters, otherwise there is no overlapping (Figure 1).

An even distribution of the sample units across all the months of the year, in line with the guidelines on the LFS quality, is a precondition for avoiding bias in the quarterly estimates due to seasonal effects, which would arise if peaks or lows in the sample actually achieved coincided with specific seasons. For this reason, the sample has been evenly allocated to all the month of the year.

Year	Quarter	Rotation groups														$o^{q}_{q'}$
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	4	A4	B3			E2	F1										1/2
2	1		B4	C3			F2	G1									---
2	2			C4	D3			G2	H1								1/2
2	3				D4	E3			H2	I1							0
2	4					E4	F3			I2	J1						1/4
3	1						F4	G3			J2	K1					1/2
3	2							G4	H3			K2	L1				1/4
3	3								H4	I3			L2	M1			0
3	4									I4	J3			M2	N1		0
4	1										J4	K3			N2	O1	0

Figure 1 – Rotating design of LFS and overlapping of a quarterly sample in two years. Overlapping, $o^{q}_{q'}$ has been expressed considering the quarter 1 of year 2 as base. q=1,2,3,4.

According to this rotation scheme the quarterly sample has to be split into 4 rotation groups, each of them with a size of 132 HH. Annual sample size is a 528*4=2112 HH. To cover 2024 and 2025 data collection 16 rotation group have been selected.
In this case the annual estimate is the mean of the 4 quarterly estimates:

$$ {}_a\hat{Y}_d = \frac{1}{4}\sum_{t=1}^{4} {}_t\hat{Y}_d $$

$$ \hat{V}ar({}_a\hat{Y}) = \hat{V}ar\left(\frac{1}{4}\sum_{t=1}^{4} {}_t\hat{Y}\right) = \frac{1}{16}\left(\sum_{t=1}^{4}\hat{V}ar({}_t\hat{Y}) + \sum_{t\neq t'}\hat{C}ov({}_t\hat{Y}, {}_{t'}\hat{Y})\right) $$

Covariances are positive because they depend on the sample overlapping among the 4 quarters.
Under the hypothesis of covariances, variances and estimates almost constant in time we get:

$$ \hat{V}ar({}_a\hat{Y}) = \frac{1}{4}\hat{V}ar({}_{\bullet}\hat{Y})\cdot\left(1+\frac{3}{4}\hat{\rho}_1+\frac{1}{8}\hat{\rho}_3\right) = \hat{V}ar({}_{\bullet}\hat{Y})\cdot effrot_a $$

where:
.Y is a generic quarterly estimate
ρ_1 (ρ_3) is the estimated correlation at 1 (3) quarter of distance
effrot is the rotation effect

For the variance estimation of quarterly changes :

$$Var\left({}_{t}\hat{\Delta}_{1}\right)=Var\left({}_{t}\hat{Y}\right)+Var\left({}_{t-1}\hat{Y}\right)-2\,Cov\left({}_{t}\hat{Y},\ {}_{t-1}\hat{Y}\right)$$

Like previously the covariance among following quarters is positive due to the sample overlapping:
under the same hypothesis:

$$\hat{V}ar\left({}_{t}\hat{\Delta}_{1}\right)=2\,\hat{V}ar\left({}_{\bullet}\hat{Y}\right)-2\,\frac{1}{2}\,\hat{\rho}_{1}\,\hat{V}ar\left({}_{\bullet}\hat{Y}\right)=\hat{V}ar\left({}_{\bullet}\hat{Y}\right)\left(2-\hat{\rho}_{1}\right)$$

The introduction of a rotation scheme like (2-2-2) improves the precision for the estimation of quarterly changes ($-\rho_1$) and worsen the annual estimates ($+\rho_1$ $+\rho_3$).

	Estimate	CV_Q	deff	Corr_1q	Corr_3Q	Eff_Rot	CV_Y	CV_NOROT
EMP_rate	59.4	3.1	3.5	0.8	0.7	0.7	2.2	1.6
LU3_rate	5.7	12.5	2.3	0.5	0.4	0.6	7.9	6.2
UNEMP_rate	4.7	16.0	1.9	0.5	0.4	0.6	10.2	8.0

Table 3. Estimates, Quarterly CVs, Deff, correlation ρ_1 ρ_3, Rotation Effect, Annual CVs for 2-2-2 and independent samples for Employment Rate, Unemployment Rate and Combined rate of unemployment and potential labour force (LU3).

MALDIVES BUREAU OF STATISTICS
Ministry of Finance & Planning
Dharul Eman Building (7, 8, 9th Floor),
Majeedhee Magu,
Male 20345,
Republic of Maldives

info@stats.gov.mv
http://statisticsmaldives.gov.mv