User Experience Observations with Improved Flame - Based Cookstoves among a Sample of South African Households

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HAP from cooking kills more than **4 million** people annually worldwide

The use of paraffin, wood and coal stoves in urban areas, and the continued use of wood in rural areas, can be linked to household air pollution and energy poverty in South Africa

Despite an extensive domestic electrification programme in South Africa (76%), the prevalent use of inefficient combustion stoves by the poorer householders remains unchanged.

In South Africa HAP kills **20,000** annually.

2,500* die each year from fire related injuries.

200,000 injured each year due to paraffin fires.

80,000 children accidentally ingest paraffin. lifelong disabilities & trauma due to burns & ingestion

Clean cooking mooted as key driver of SDG success.

(Woiwode, 2013; Martin II et al., 2014; Yamey et al., 2014; GACC, 2016)

100 million households by 2020

(GACC, 2016)

- safe, inexpensive and improved stove designs could lead to a significant reduction of household air pollution (HAP)

- near all stove disseminations fail (long term)

- service design techniques have been successfully applied in the fields of public health and the environment

- the focus on the user experience was absent in near all of the unsuccessful stove dissemination projects.

Research Aim

map out the user experience for improved flame-based cookstoves among South African low-income households in order set the bahaviourial goals for the next steps in a prospective service design implementation

Methodology

an observational research study was undertaken that integrated user oriented, qualitative, ethnographic research approaches – as described and applied by.

The field study comprised observational study of household cookstove use, interwoven with interviews (structured and unstructured) of the main cooks.

The results are presented in the form of a written summary of the observations, synthesised with the interviews.

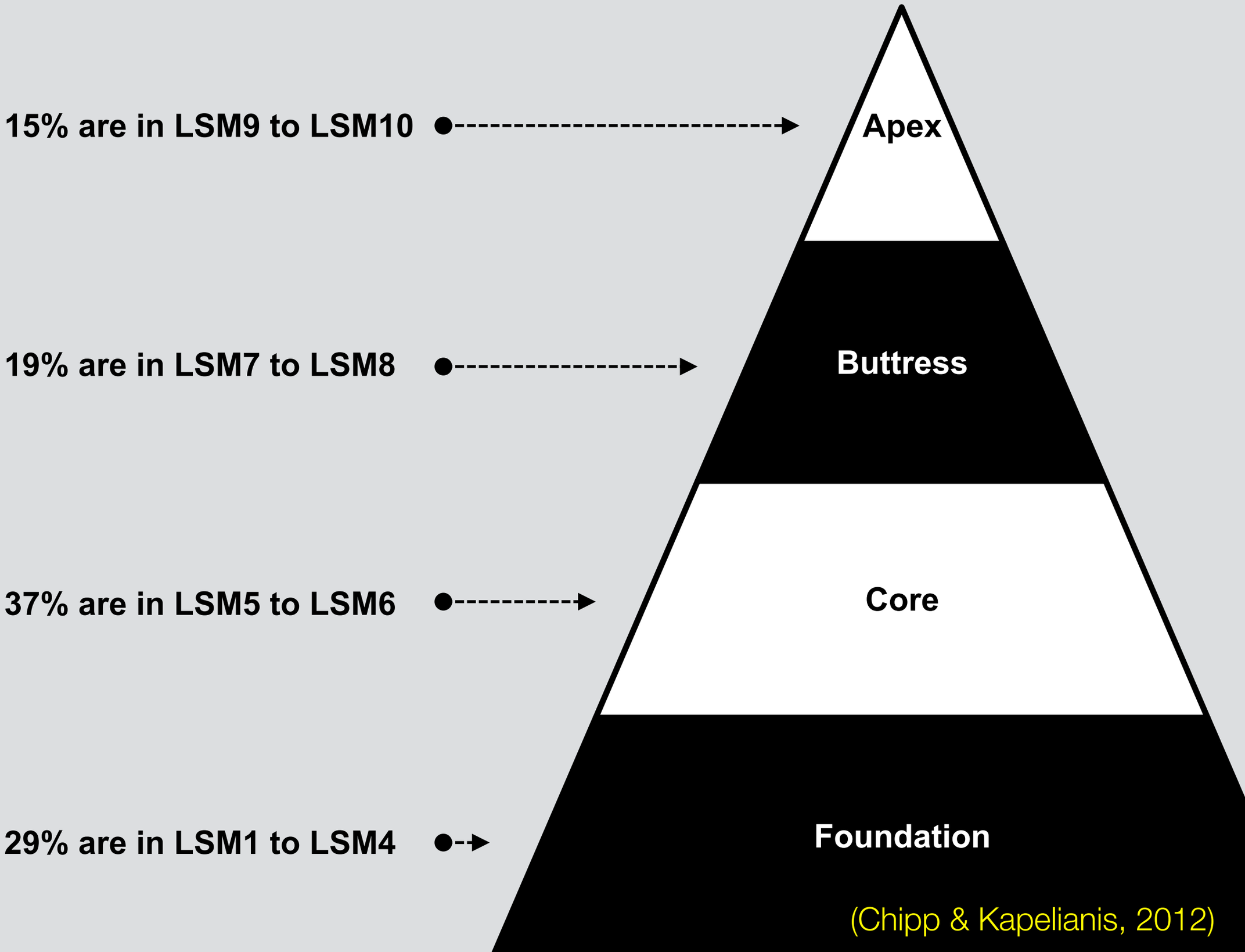
(Kelle, 2006; Suri, 2006; Tollin & Carù,2008)

sample selection

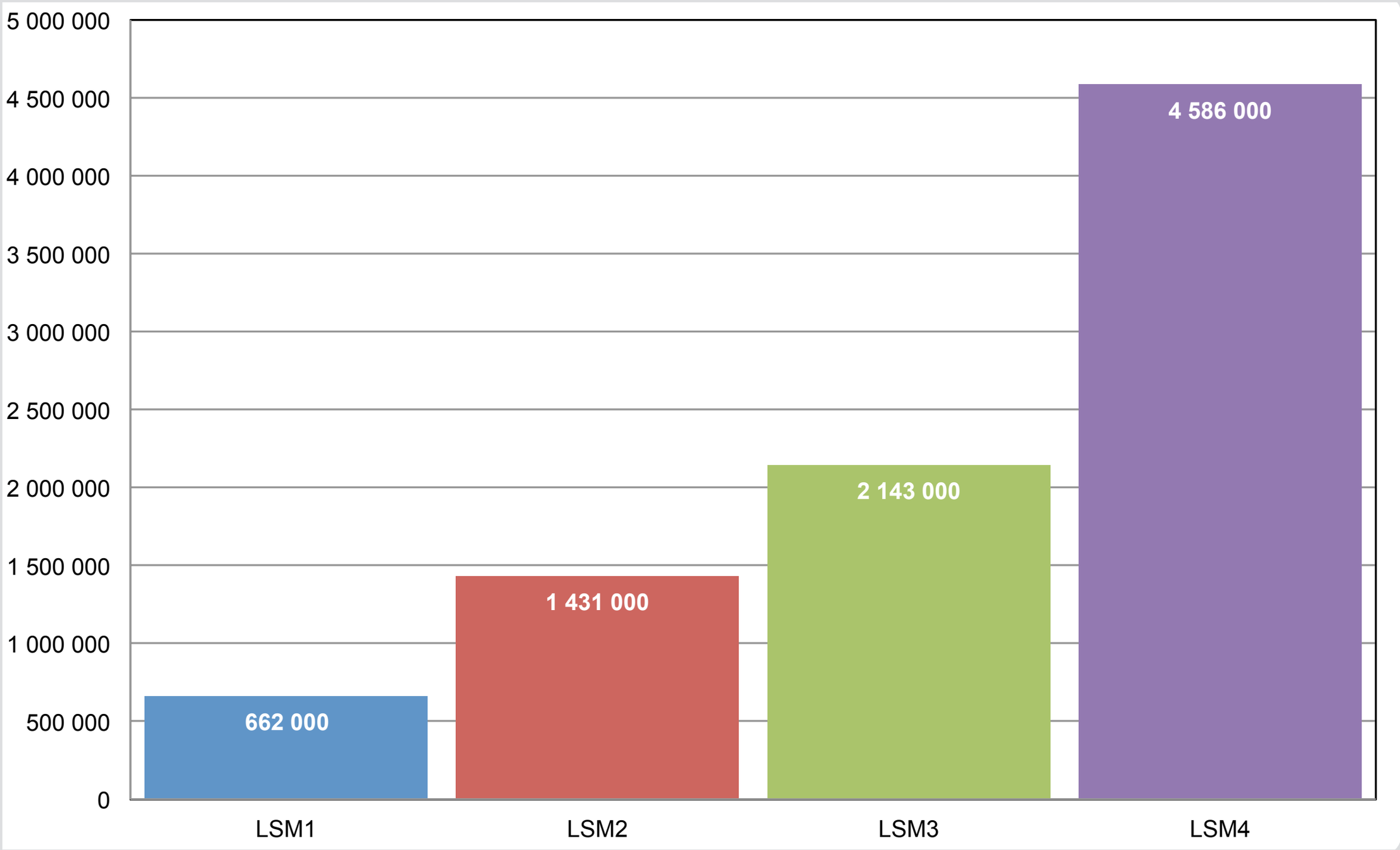
BoP + **Living Standards Measurement Tool** (LSM) provided by SAARF

6 representative households covering the four potential user segments, were selected from a group of 65 households in urban and rural areas of South Africa.

BoP + LSM

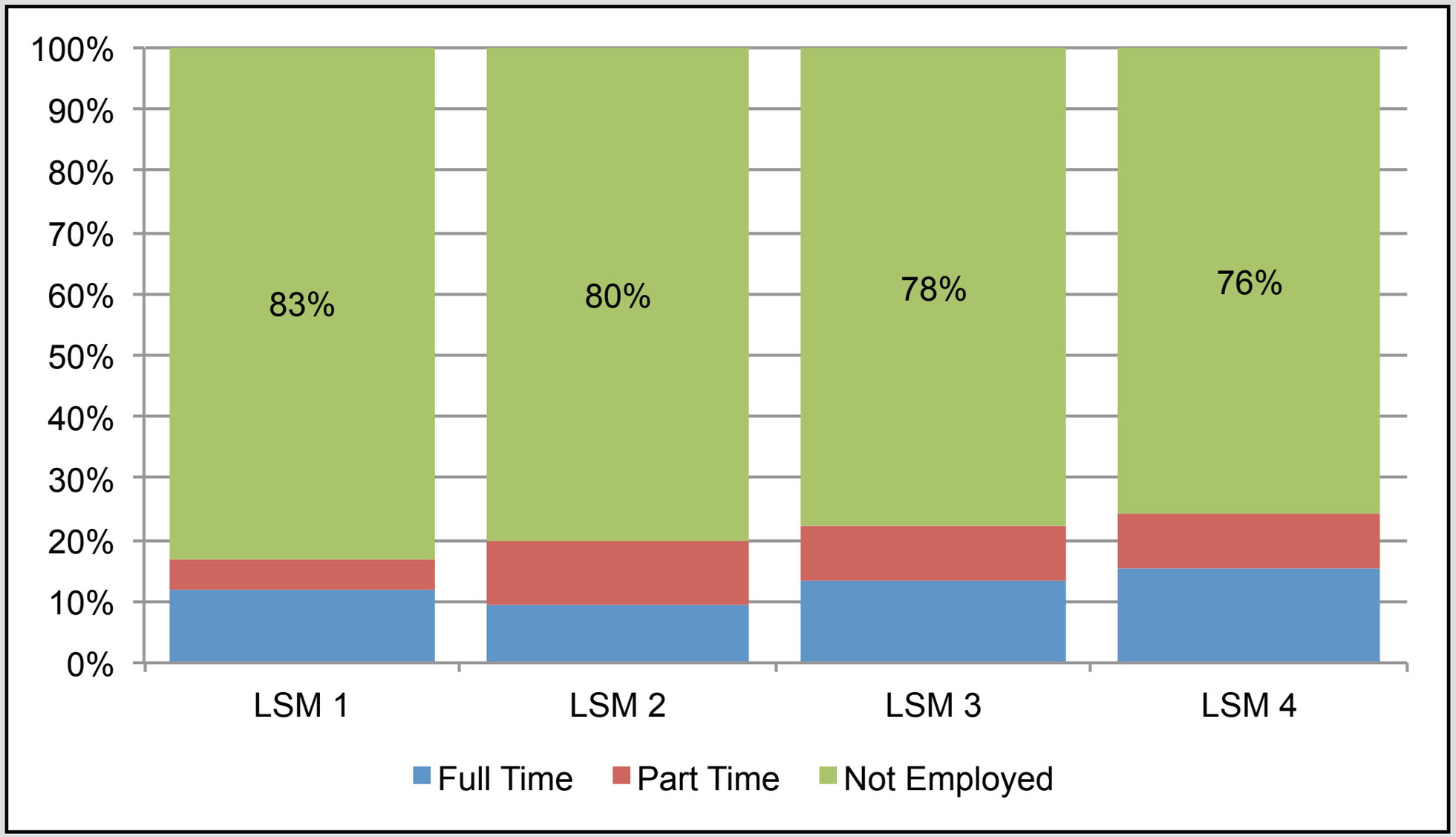

15% are in LSM9 to LSM10
19% are in LSM7 to LSM8
37% are in LSM5 to LSM6
29% are in LSM1 to LSM4
Apex
Buttress
Core
Foundation
(Chipp & Kapelianis, 2012)

Number of households within groups LSM1 to LSM4



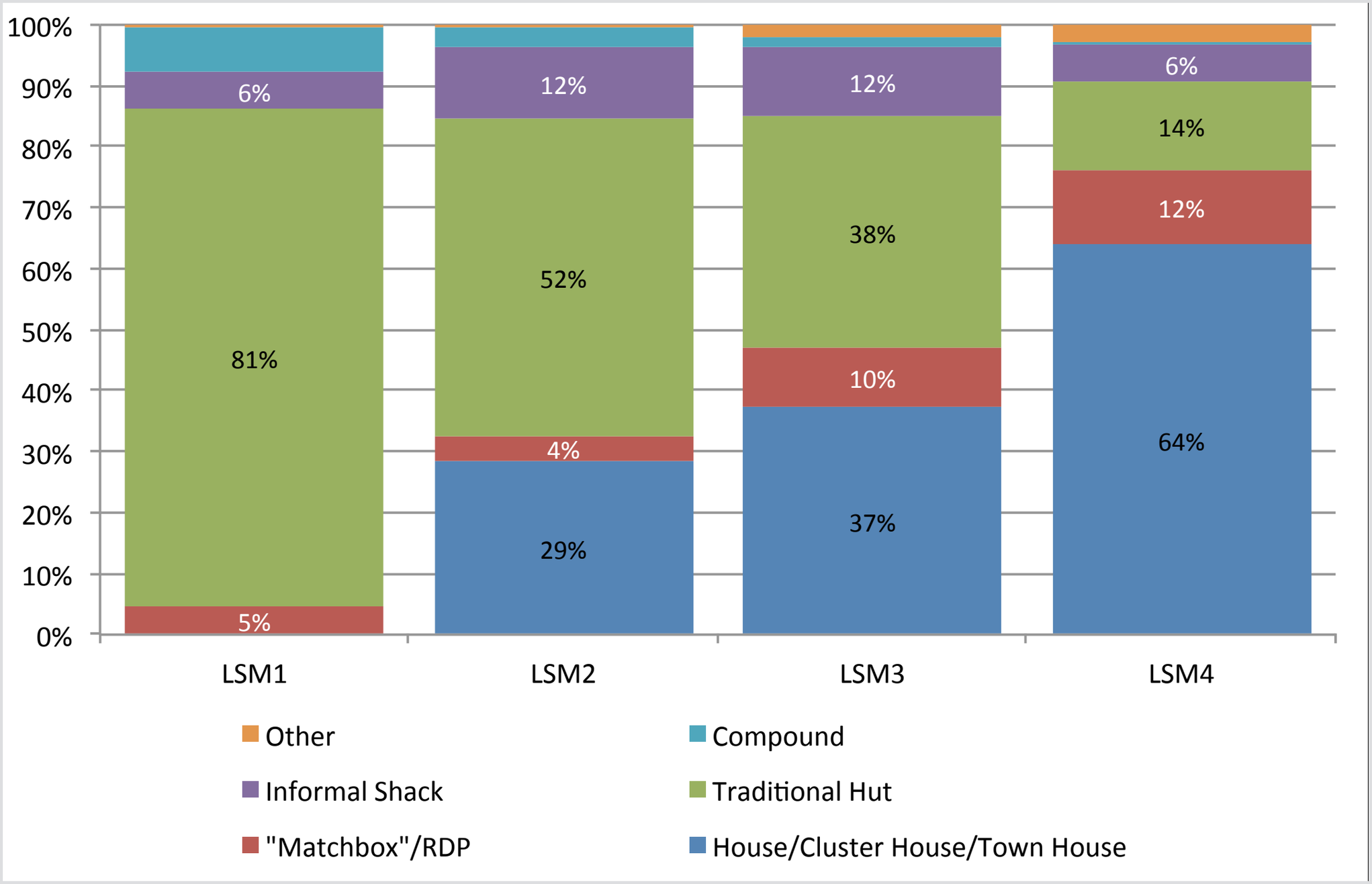
(SAARF, 2013)

Employment within groups LSM1 to LSM4



(SAARF, 2013)

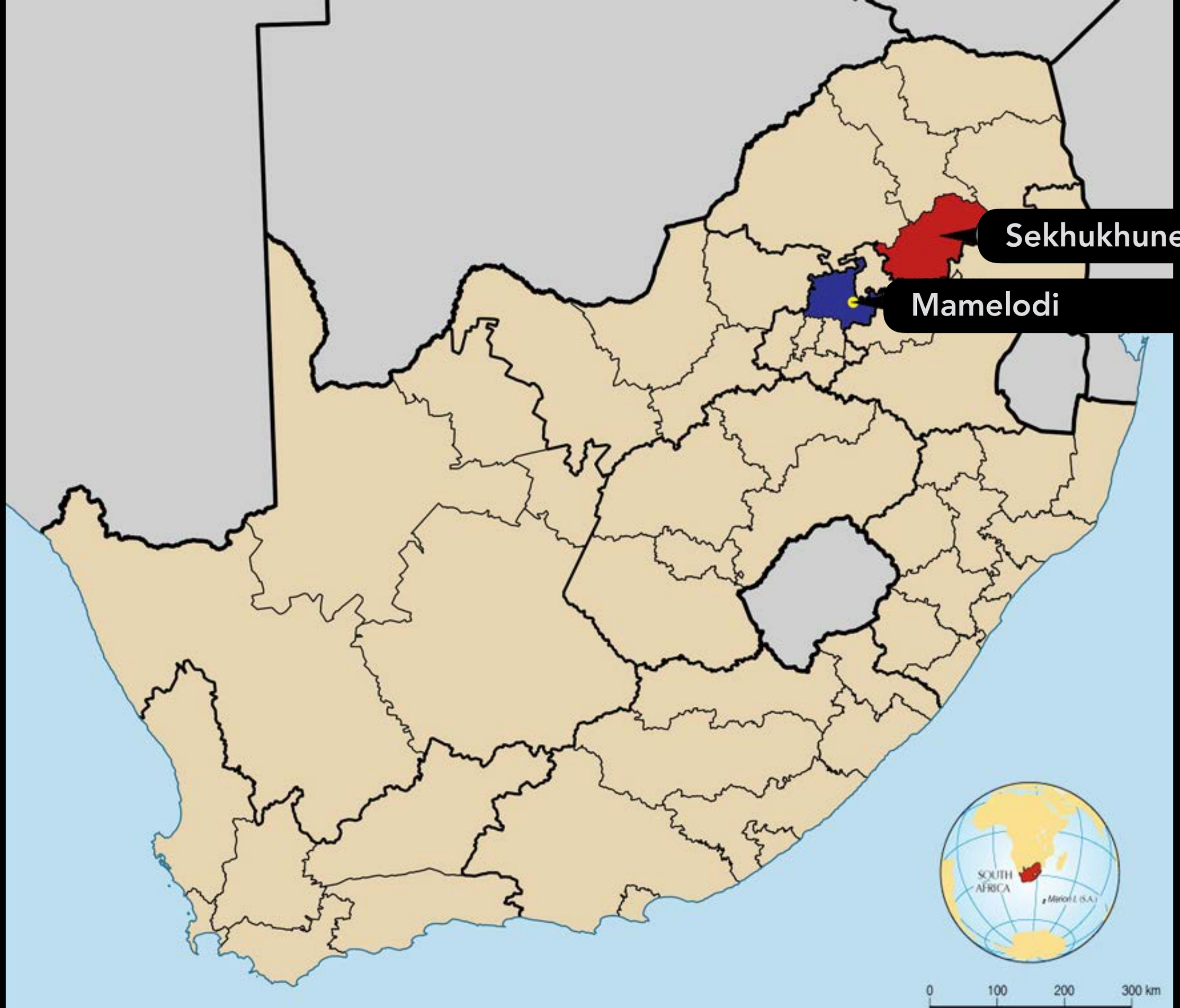
Frequency of dwelling types within groups LSM1 to LSM4



(SAARF, 2013)

	LSM 1	**LSM 2**	**LSM 3**	**LSM 4**
Household Head	50% Female/Male	> 50% F	> 50% F	> 50% M
Location	rural	rural, urban	urban, rural	urban
Income type	Social grant	Social grant Irregular income	Social grant Irregular income	Social grant Some wages
Monthly income	R1500	R2000	R2500	R3000
Who cooks	Women > 14 years	Women > 14 years	Women > 14 years	Women > 14 years
Energy carrier	Wood	Paraffin Electricity Wood	Electricity Paraffin	Electricity Paraffin
Decisions	Short term Convenience	Short term Convenience	Short term Convenience	Short term Convenience

(SAARF, 2013)


Sekhukhune
Mamelodi
SOUTH AFRICA
Marion I. (S.A.)
0
100
200
300 km

LSM Group	Sample Area	Dwelling Type	Primary Cookstove
LSM2 urban	Mamelodi Phase 2a	Informal shack	Paraffin stove
LSM2 urban	Mamelodi Leeufontein	Informal shack	Paraffin stove
LSM3 urban	Mamelodi Phase 2b	Small house	Electric, paraffin
LSM4 urban	Mamelodi RDP Ext 18	RDP house	Electric stove
LSM1 rural	(Sekhukhune (Kotsiri village	Traditional dwelling	Open fireplace
LSM2 rural	Sekhukhune (Hlogotlou (village	Traditional dwelling	Open fireplace, electric stove

1+2. Mamelodi Phase 2 | urban | LSM 1+3

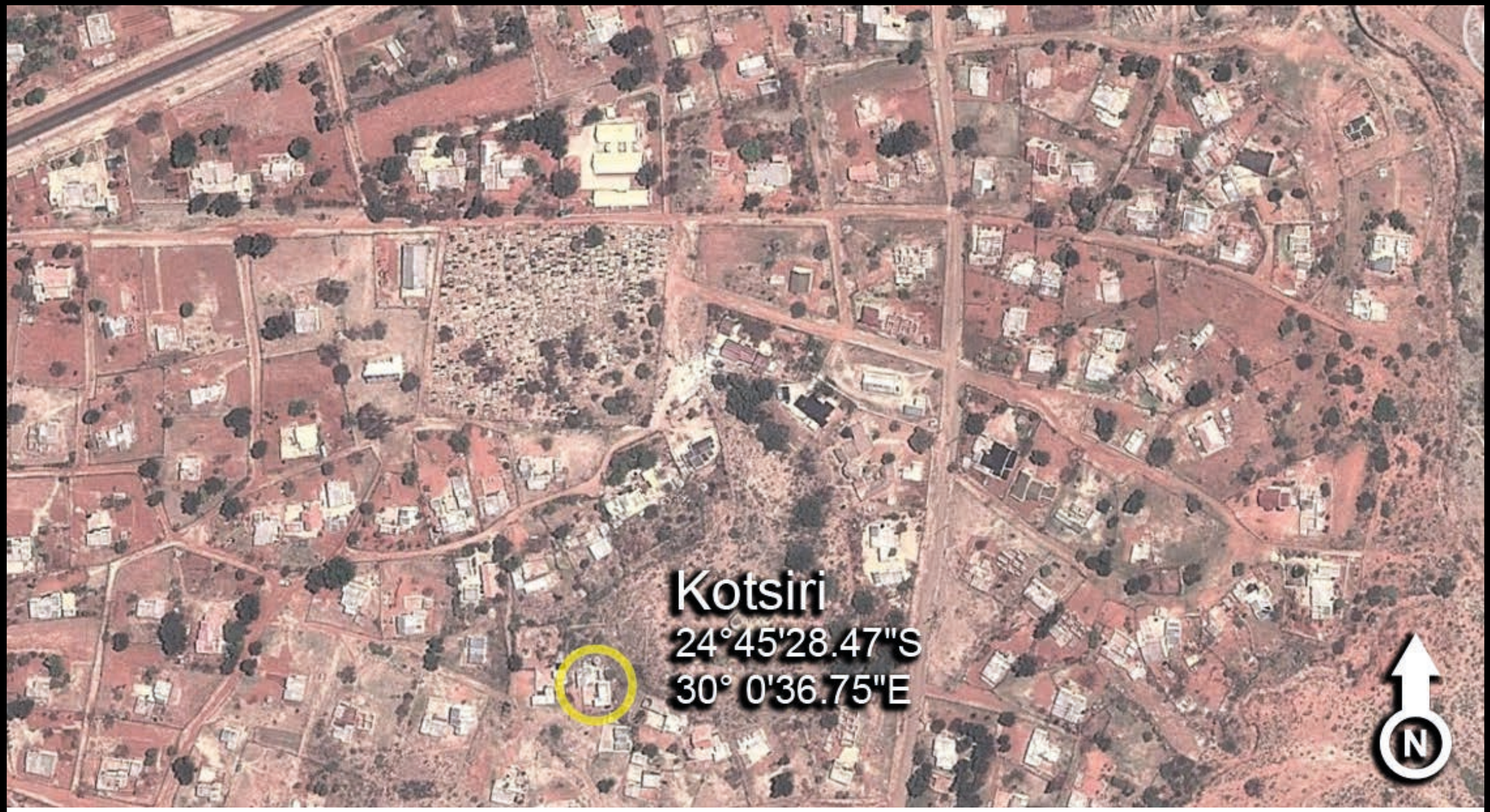
3. Mamelodi Leeufontein | urban | LSM2

4. Mamelodi RDP Ext 18 | urban | LSM4

sample household location and coordinates

200m

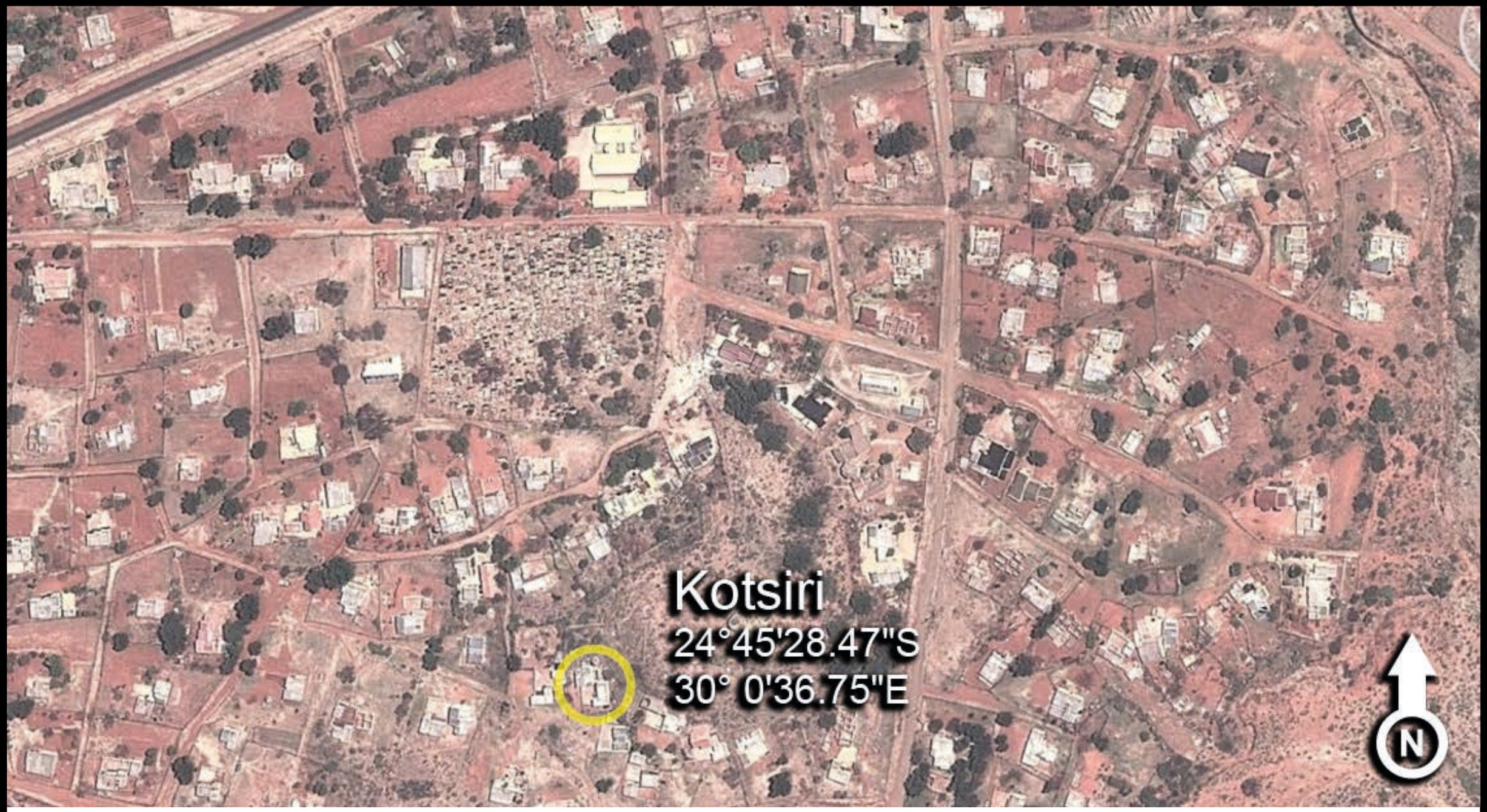
5. Kotsiri, Sekhukhune | rural | LSM1



sample household location and coordinates

200m

6. Hlogotlou, Sekhukhune | rural | LSM2



sample household location and coordinates

200m

Criteria for improved cookstoves

- flame-based stoves that burn biomass, paraffin & gas (not coal)
- R200 and R400 per year on household assets (micro finance)
- SA's sophisticated distribution and manufacturing infrastructure
- SA's food culture (heat)
- stove durability & mainenance
- local availability
- fully assembled

Selection of improved cookstoves

The following stove candidates were selected – after consultation with the UJ SeTAR Centre, KayaGAS, Restio and Readymade.

- Laduma cast-iron stove
- Stovetec Ecozoom (Rocket)
- Legally compliant Panda paraffin stove
- Simulated Arivi paraffin stove
- LPG stove (single hob including gas cylinder)
- LPG stove (cast iron double hob gas stove)
- Alva stainless steel single gas stove with auto ignition switch

Laduma Stove
Retail Price: R1 300 – R1 700
Fuel Type: coal/charcoal/wood
Supplier Ndebele Stoves (Pty) Ltd
Attributes: single plate cast-iron stove with 3m chimney section

Ecozoom Versa Stove
Retail Price: R350
Fuel Type: charcoal/wood
Supplier: Restio (Pty) Ltd
Attributes: improved wood and charcoal stove

Legal Panda Stove
Retail Price: R80 – R120
Fuel Type: Paraffin
Supplier Cainellie Enterprises
Attributes: low-cost, poorly constructed, unpressurised, wick-based stove

Xinxiuli Alpaca unpressurised stove
Retail Price: R300 – R1 000
Fuel Type: Paraffin
Supplier: Xinxiuli
Attributes: simulated unpressurised paraffin Arivi stove with robust adjustment switch and improved safety features.

Alva 4.5kg single combo (gas stove

Retail Price: R135 – R230 including gas cylinder

Fuel Type: LP Gas

Supplier: Stingray (Pty) Ltd

Attributes: single cooker plate with 4.5kg gas cylinder

Campmaster Portable Cooker
Retail Price: R200 excluding Gas cylinder
Fuel Type: LP Gas
Supplier: Campmaster
Attributes: cast-iron double hob gas stove

Alva Single Hob Gas Stove
Retail Price: R150 excluding Gas cylinder
Fuel Type: LP Gas
Supplier: Stingray (Pty) Ltd
Attributes: stainless steel single gas stove with auto-ignition switch

Research Instruments

The observational research consisted of structured and unstructured interviews.

Self-reporting technique of non-participant observation of cooking stove use and lifestyles of the cooks was employed as a method of data collection, throughout the site visits (6 field workers).

- general observations of the households,
- existing cooking behaviour
- observations of improved cooking stove use

Observation & Interview Methodology

The fieldwork was conducted over a four-week period in July 2013.

First two weeks Mamelodi, followed by one week in Sekhukhune, with two households visited per week.

The first day was spent observing existing cookstove use. For the remainder of the week, the use by the householders of the candidate stoves was observed, with comments noted.

the children, acted as “food testers” to keep them engaged

Existing Cooking Stove Use Observations

All households were followed through the entire process of preparing a meal using their own cook stoves. This process extended from buying or collecting the fuel and food, to cooking the meal and cleaning up afterwards. The interviewer was able to deepen the conversation about cooking practice with the cooks, to understand their daily routine, to interact with other people in their households, and to discover tangible cues about their needs and desires. To further understand user behaviour, discussions and observations of other purchases and decisions helped to further understand which user attitudes applied to all products and which were specific to cooking stoves.

Improved Stove Use Observations

The candidate cookstove demonstrations were integrated into the meals that were being prepared in the households during the week, with the cook presented with the interviews conducted during and after the cooking process. The interviews were primarily concerned with the use of the various cooking technologies made available by the researcher. Each stove was presented to the respondents, with the same amount of basic information that would be provided if it was to be purchased from a local retailer or spaza shop. The cooks were familiarised with each stove and shown how to light it. The Laduma stove was tested outside the dwelling simply because it was not always possible to fulfil the requirement (i.e. the necessity) of connecting the stove to a chimney.

Structured and Unstructured Interviews

The interviews were conducted in English and in Northern Sotho. Answers were not suggested nor read out aloud. The interviews were captured and transcribed.

Analysis Methodology

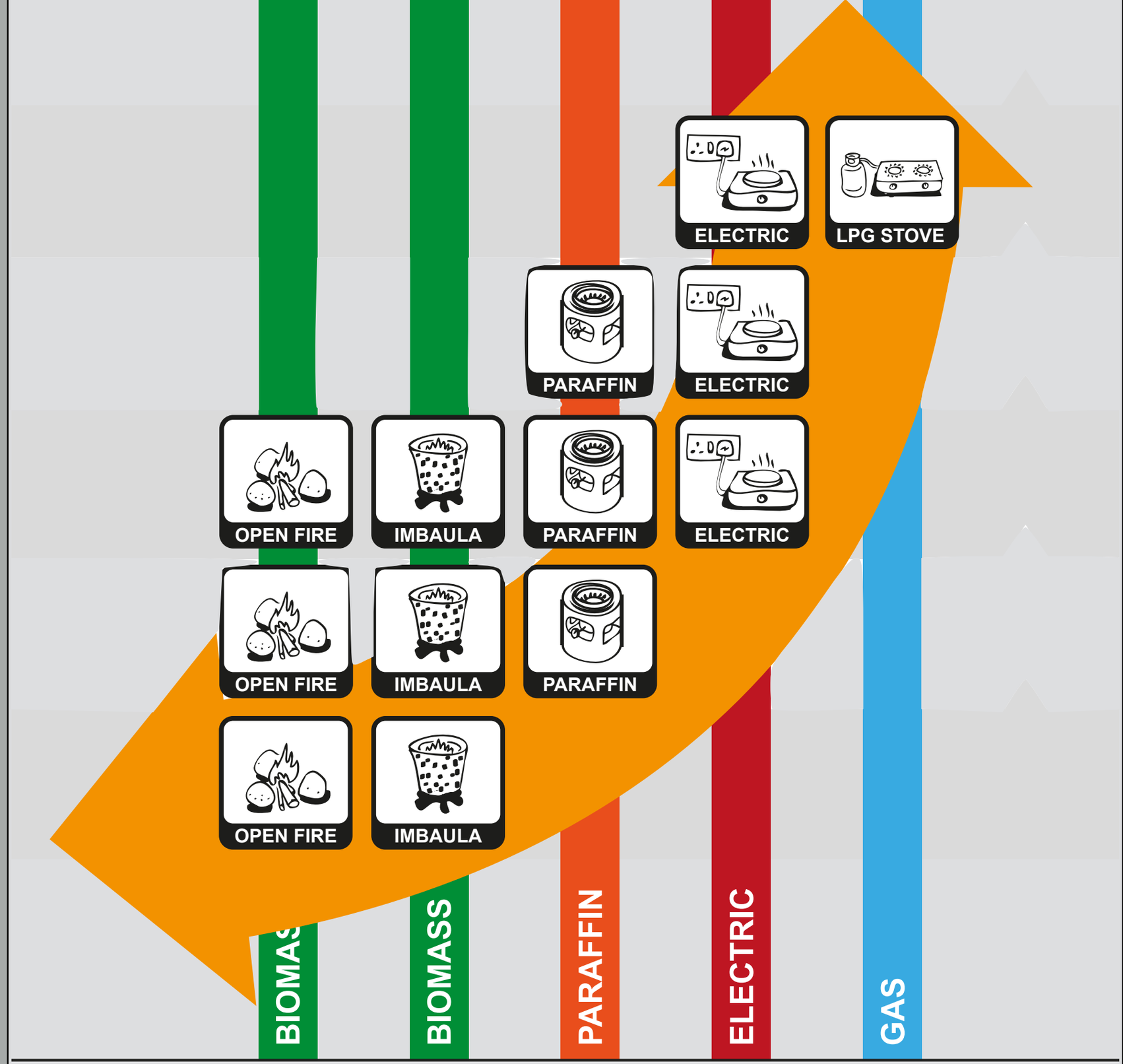
The data was analysed using a combination of ethnographic and phenomenological approaches as suggested by Maggs-Rapport (2000). The captured field notes, videos, images and tabulated questionnaire results were critically examined and synthesised by the researcher. The analysis began during the fieldwork. The researcher reflected on the personal experiences and integrated them in the final summary. The information elements were organised and summarised according to the individual households, with the results intended to both form a basis of the conclusions relevant to discovering the patterns, ideas and explanations for cookstove related behaviour among the user base.

Findings


HI-LITE

Findings: All 4 LSM categories

- fuel & stove stacking (prepaid electricity + paraffiin + wood)
- food | transport costs | household energy expenses
- affordability of fuel is a major factor (first fuel then stove)
- little complexity in cooking - starches cooked with vegetables dominate - meat occasionally
- women do the work & most purchases
- hedging vs. immediacy of cooking (long term vs. short term)
- health not an issue (smell is, fear of explosions)
- the women prefer quality of appliances


LSM5+
LSM4
LSM3
LSM2
LSM1
ELECTRIC
LPG STOVE
PARAFFIN
ELECTRIC
OPEN FIRE
IMBAULA
PARAFFIN
ELECTRIC
OPEN FIRE
IMBAULA
PARAFFIN
OPEN FIRE
IMBAULA
BIOMASS
BIOMASS
PARAFFIN
ELECTRIC
GAS
BIOMASS
Energy Carrier
IMBAULA
Cookstove Technology
Human Development Path

Findings: Stoves 4 LSM categories

- Rural LSM1 in rural Sekhukhune still prepared their meals using traditional open fires
- LSM2 & LSM3 showed similar cookstove preferences among the demonstration models
- LSM4 distinctly did not show any particular preference for any of the improved cookstoves offered.

Findings: User Experience Observations

- All except one household experienced the greatest ease of cooking when using LPG or electricity.
- While many expressed initial fear concerning the use of the gas cylinders, with use the fear lessened, with the cooking convenience noted when comparison with the performance of paraffin stoves.
- The double hob gas stove found appeal simply because of the ability to cook with more than one pot.
- The self-igniting switch on the Alva LPG, stove appealed to three of the cooks.

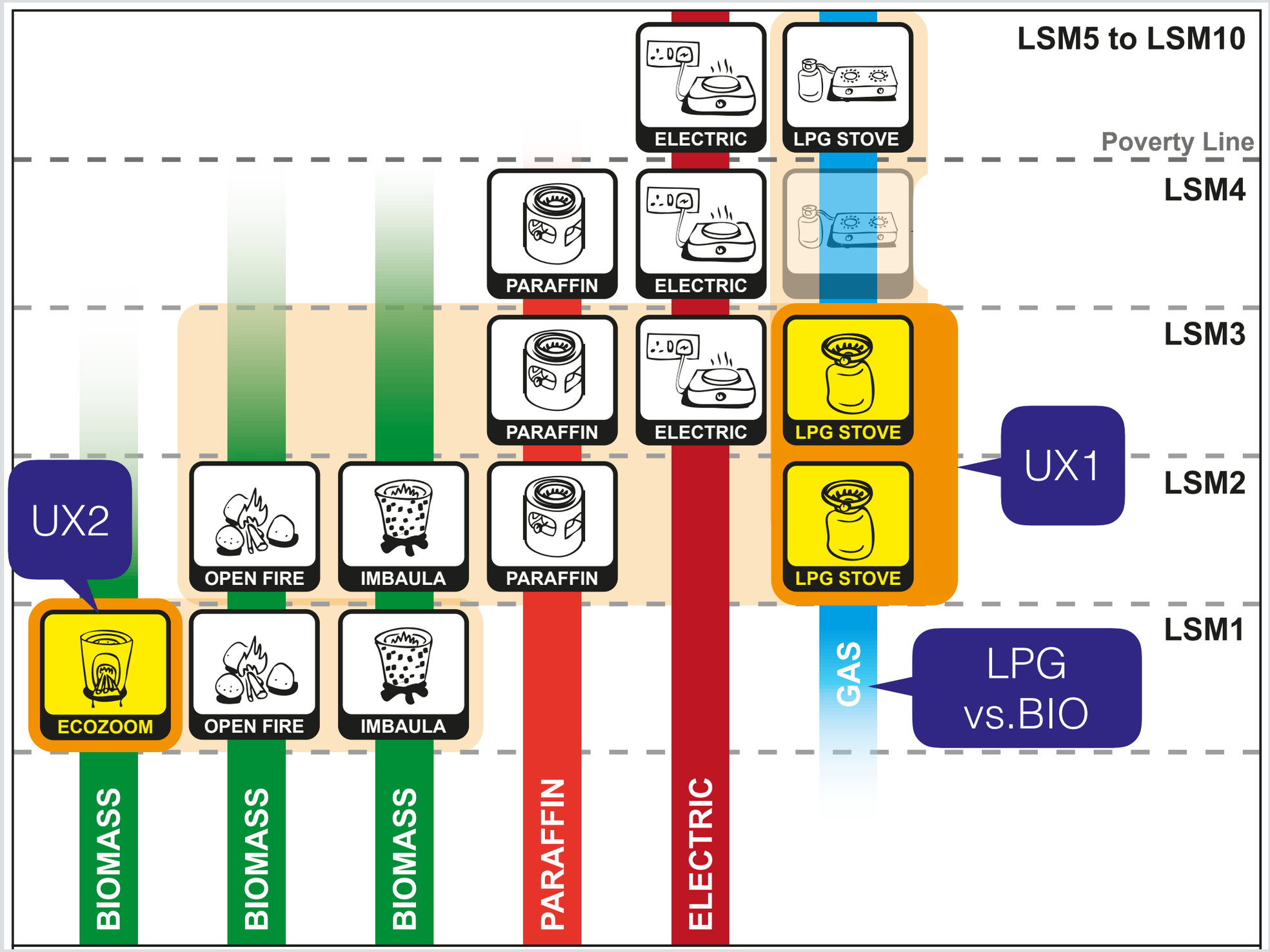
Findings: User Experience Observations

- The larger, more solid, paraffin stove used to simulate the possible future Arivi was preferred above the Panda, yet the smell was still considered a drawback.
- The households with *imbaulas* were particularly interested in the Ecozoom. (difficult to master, great for cooking rice or maize porridge, but at hearing the price, the cooks considered it rather expensive.
- Ecozoom needs additional time and labour for preparing sticks of wood to fit through the small opening

Conclusions

With a clear difference in cookstove use found between the extremely poor, mainly rural households (i.e. LSM1) and households beginning to emerge from poverty (i.e. LSM2 and LSM3), a two-tier behavioural goal is suggested.

- For South Africans living in the LSM2 and LSM3 category the goal would be to shift to an LP Gas stove
- For rural South Africans living in the LSM1 category, an improved biomass stove


LSM5 to LSM10
Poverty Line
LSM4
LSM3
LSM2
LSM1
ELECTRIC
LPG STOVE
PARAFFIN
ELECTRIC
PARAFFIN
ELECTRIC
LPG STOVE
UX1
OPEN FIRE
IMBAULA
PARAFFIN
LPG STOVE
UX2
ECOZOOM
OPEN FIRE
IMBAULA
GAS
LPG
vs.BIO
BIOMASS
BIOMASS
BIOMASS
PARAFFIN
ELECTRIC

Recommendations

The preliminary results of the first phase of the design process suggests:

- flexibility crucial in any service design framework
- development of design “tools” is being explored from which strategies can be developed for local contexts by partners or publics rather than the remote design and importation of a stove (i.e. the elusive “silver bullet” stove to meet all needs)

Coming soon…

Willingness to Pay: (size durability & finance)

Thanks!

- SeTAR Centre (UJ)
- LeNSES Team
- CPUT Team
- Ngwato Magakwe, Billy Zulu, Kotsiri Village