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LURAS Lao Upland Rural Advisory Service

Labour Saving Technology for Rural Women

Review conducted under the Lao Upland Rural Advisory Service (LURAS) Phase II

Chris Wardle

March 2020

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Acronyms

ABC	Advanced Biomass Cookstove
ADB	Asian Development Bank
BCOME	BCEL's Community Money Express
DAFO	District Agriculture and Forestry Office
DDR	Direct Drilled Rice
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
GBV	Gender based Violence
GFS	Gravity Flow (water) Systems
GOL	Government of Laos
HH	Household
IAA	Integrated Agriculture Aquaculture
ICS	Improved cookstove
ICT	Information Communication Technology
IFAD	International Fund for Agricultural Development
IGA	Income Generating Activity
NTFP	Non-Timber Forest Product
LST	Labour Saving Technology
LURAS	Lao Upland Rural Advisory Service
LWU	Lao Women's Union
SNV	Stichting Nederlandse Vrijwilligers
ToC	Theory of Change
WF	Women Friendly
WWL	Women's Workload
UNCDF	United Nations Capital Development Fund

Contents

1. Summary

The Lao Uplands Rural Advisory Services (LURAS) project is a program of the Swiss Agency for Development and Cooperation (SDC) and the Government of Laos, implemented by Helvetas in partnership with the Department of Technical Extension and Agro-Processing (DTEAP).

Labour-saving technologies (LST) and practices play a crucial role in releasing poor rural women of all ages from unpaid time burdens so that they have more time for productive work and to participate in development opportunities (Bishop-Sambrook, 2016). Women and girls carry out the bulk of unpaid domestic work. The work typically involves water and fuel collection; food processing, preparation and cooking; travelling and transporting; and caregiving. It is laborious and time-consuming in many rural areas where there is no or limited access to essential public services and labour-saving technologies. Coupled with women's often unpaid role in subsistence farming, this means rural women spend a larger proportion of the day on unpaid and undervalued tasks than men. This can restrict the income they bring in and have control over, their mobility and voice, and the health and nutrition of the whole family.

This study, primarily desk-based, supports the LURAS 'Green Extension' strategy through a **review of options for Labour Saving technology (LST)**. The effectiveness of LST is subject to a range of influences. It is hypothesised that positive changes to influences regarding gender inequality and gender-assigned tasks will positively influence change in rural women's workloads (WWL) as well as the success of LST in providing genuine reductions in the time and labour effort of rural women. Understanding the nature of rural women's work is a key factor to better understand the issue of workload burden, time poverty and approaches to support workload reduction. There are barriers and enablers to women using LST as well as approaches that can support adoption of LST.

Influences of rural women's workloads (WWL) were considered in terms of (a) influences of gender inequality (impacting roles, agency, and decision-making regarding work expectations and division of labour); and (b) external influences of gender assigned tasks, (impacting access to skills/information, changes in work tasks and methods). For gender inequality, seven categories of influence were identified: culture, poverty, agriculture, informal work, information, service access, geography and physical mobility. For example, culture is a significant influence of gender norms and therefore division of labour; women provide considerable informal work where less income generation influences control over financial resources and decision making, including workload decisions. External/project influences over gender-assigned tasks can include (a) interventions designed to address gender inequalities and women's agency; (b) specific LSTs activities; (c) actions that result in unintended WWL increase (e.g. livestock raising); (d) actions that reduce WWL specific tasks, where this was not the primary objective (e.g. Water supply).

The '*Laowomen'* project (under LURAS) identified three categories of **rural women's work**: domestic; farm-work; IGA; further observing that women provide most of the labour for growing crops, spend most of their time in the fields, and work (if available) as hired hands for extra family income. Women rely on men to take them to the market as most cannot ride motorbikes. Villagers see the importance of education and keep their children in school, which means women receive less help with housework and work in the fields. The FAO country gender assessment (2019) found that in both the rice season and non-rice season women have less non-work time (eat/rest/sleep), significantly so in the rice season. The LWU gender profile analysis (2018) notes that women do most of the farm work and tending livestock, and spend long hours performing off-farm and household chores.

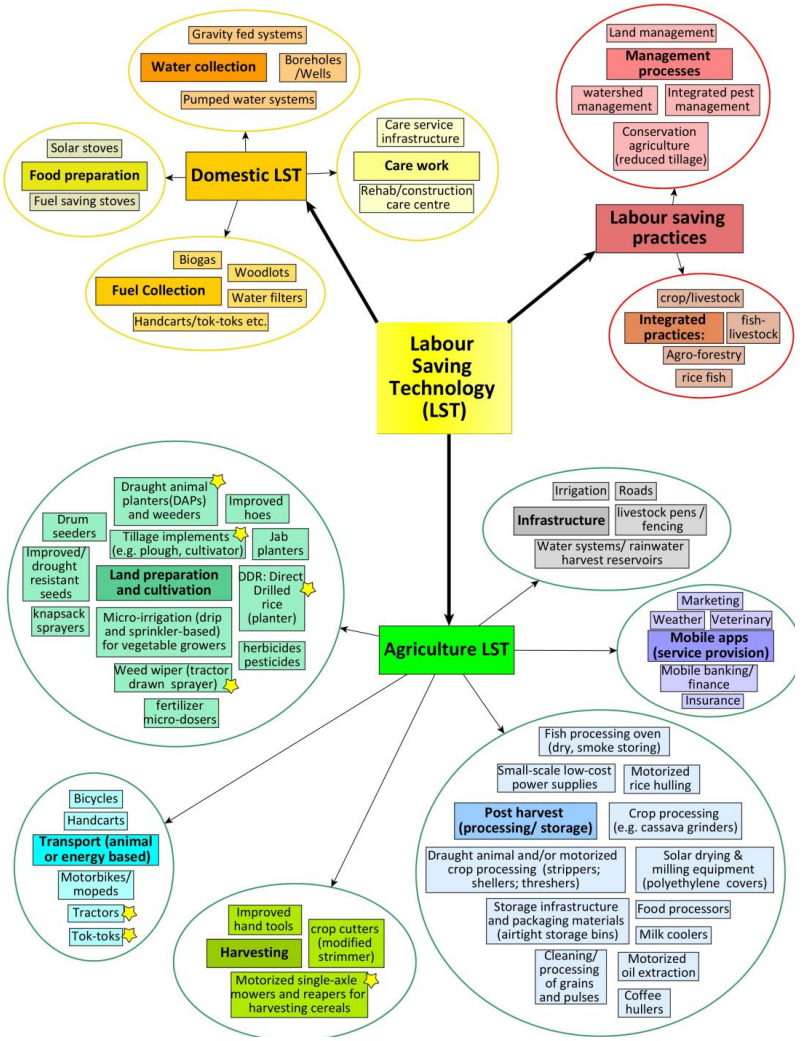
Women's disproportionate work burden leads to **time poverty** (Grassi et al, 2015) which restricts women's well-being and their engagement in activities of value, including remunerative activities. LST is not necessarily a "quick fix" as issues surrounding the lack of access to and **adoption of technology** are context-specific and complex. Social norms and behaviour need to be targeted for change to take place. Women's technology adoption rate can be low, research (globally) suggesting that this is mostly due to women's limited access to complementary inputs and services (time poverty can include time for learning skills that would allow women to adopt new technologies). The study hypothesises that the application of gender transformation and new practices/LST to inequitable workloads will result

in reduced more equitable workloads. Scenarios are considered where an LST to reduce WWL is introduced where either, (1) women use the LST, (2) men use the LST, (3) both men and women use the LST, (4) the LST is not used. The risk in both results 1 and 2 is that the time saved will be reallocated to other women's labour work, or some of the men's work shifts to women as they take on the LST task. This suggests that negative consequences of LST introduction should be anticipated and that introduction of new practices (LST) should be coupled with gender transformative activities. It is also noted that LST often addresses the symptoms but not the causes of high WWLs. Time saved for a specific task may not translate as time saved over the working day.

Barriers to the adoption of LST can include low education (affecting capacity for informed choices); Access to inputs (credit, consumables, information); Men's control over technology; Household dynamics: Time availability: Physical challenges (e.g. LST designed for men); Social norms. Enablers can include Gender/ socio-economic analysis; Gender transformation; Consultation in LST design, Added value (LST as an IGA). (Full lists/description in the main report).

The process for **selection/implementation** of LSTs (Bishop-Sambrook, 2016) should include: Identification (of workloads through gender-sensitive participatory approaches, to understand the time poverty of women, men, youth and children); Design (using gender-sensitive participatory tools to listen to technology preferences of different community members); Implementation (facilitating women's participation and real choices in design, planning, siting, construction, operation, maintenance, management and monitoring); O&M (training women in maintenance/repair or for more complex LSTs, provide awareness of external support).

Labour Saving Technology – Domestic, Agriculture and practices. based Grassi (2015), with additions from further reading including Bishop Sambrook (2016)



An **initial menu of options** for consideration in LURAS target communities has been developed. A detailed review of each option is annexed. It is subdivided into three categories: Domestic workload reduction; Agricultural workload reduction; Other options (less women friendly/ or not 'stand-alone' interventions for WWL reduction). Research implies that LSTs in the domestic sphere are more likely to be used by women and translate into actual workload reduction rather than shifting the saved time and effort to a different task. The agriculture options suggested are potentially 'women-friendly', but there remains a risk that men take over the task, displacing women to other labour tasks, if introduced without a gender-sensitive process. The 'other options' are either likely to be used by men, albeit to support women's labour tasks, such as mechanised rice seed planting, or need to be part of a wider carefully managed program (such as knapsack sprayers which could be used by women to reduce their weeding tasks but also require herbicide use expertise).

Domestic LST	
Fuel saving stoves	Reduce fuel collection/cooking time/effort, and fuel use). Common across Laos. SNV and Civitas promote specific models. Uptake may be impacted where there is no electricity, and open fires provide HH light/family socialisation. Suitable in N. Laos where cooking is normally with wood.
Rice mills. *Motor or water-power.*	Reduces effort to pound rice by hand. Some report manual husking for a family can take up to 4 hours/day. Widely used. Requires good gender transformation approach/women group mgt.
Water filters	Ceramic pots filters reduce time/effort to collect firewood and boil water; reduces working days lost to illness). Filters eventually need replacement (consider supply to remote areas/cost)
Biogas	Latrine, with domed pit at side (often with opening for animal/biomass waste). Reduces cooking fuel needs and time/labour to collect fuel. Regular latrine use and free-range livestock may limit composting material. Need safe set up (re gas).
Water supply	A well-designed system, with women's consultation in design can reduces labour/time needed to fetch water, primarily a women's task. Must consider protected/safe water.
Grind machines: livestock feed	Small machines used to grind animal feed. Can reduce time and effort in feed preparation for domestic livestock (the role of women).
Other appliances	Electrification enables a variety of domestic appliances to reduce workload. E.g. electric cooking pots/fryers; rice steamers; washing machines. Can also support IGA in some cases.
Agricultural LST	
Rice cutter	Strimmer with circular blade/wind-rower. Replaces manual harvesting, up to 7.8x faster. Lightweight models available; can focus on women users to avoid reassignment to other labour.
Drum seeder	Manually pulled plastic drum seeding pre-germinated rice. Replaces manual transplanting; can address labour scarcity during planting; FAO trialled this. May reduce casual labour options.
Handcarts	Pushed wooden; two-wheels (pneumatic). Reduces effort/time for transport incl. wood, water, and harvesting NTFP and crops. Men also use handcarts. Utility is impacted by road access.
Irrigation	Small scale irrigation reduces weeding (primarily a women's task). Can reduce water collection for livestock/ some domestic tasks.
Barbwire Fencing	Reduces annual labour to construct/maintain wooden cattle-proof fencing in steep upland slopes. (Some documents suggest this is a male task, so requires review before promoting).
ICT	Mobile phones support marketing, accessing information, accessing financial services. E.g. weather/ livestock disease knowledge supports decision making regarding work carried out by women (e.g. planting; livestock raising).
Other options	
Knapsack sprayer	Reduces 'head down' labour -hand-weeding. Herbicide reduces weeding time by 88-97%. Need technical knowledge and safety management (re herbicides/pesticides) linked to crop activity.
IAA	Raising fish in paddy can reduce effort to source protein-food or NTFP and reduce weeding: fish feed on weeds, reduce pests and fertilize rice. Managing the fish can add an extra workload for women. Fingerlings are an annual cost.
DDR *Direct Drilled Rice*	Machine replaces manual transplanting effort, most likely used by men. Risk of WWL transferred to other labour activity. More suitable to lowland (more paddy).
Single axel tractor *Toktok*	Reduces strenuous carrying tasks; rotovating; transport of wood, farm products and people to/from field/HH/market. (Mopeds can do some of this and therefore are also LST). Often it will be men to use the tok-tok. Gender approaches can encourage uses that reduces WWL tasks.
Food processing	Seasonal foods processed when fruit/food is more available and can be stored for use in the off season, reducing effort of finding NFTPs in the off-season (but processing is additional work).
Rice/Crop processing	Mechanisation of planting; transplanting; harvesting; drying; threshing; milling and so on. Machines are likely to be used by men, with the risk of WWL transfer to other labour.

Recommendations for further study include a workload time-efficiency study (Household level, before and after LSTs, compare for domestic and agricultural). Most 'evidence' of workload change post-LST is anecdotal; review impact of LST on women's income opportunities and their agency; Review market availability of LST to upland villagers; Review ICT options in upland communities; Study factors that influence adoption of specific LSTs; Review electrification impact on LST and the barriers to this transition; Biogas pilot using coffee huller waste (SNV interest).

2. Introduction

2.1 Background

Labour-saving technologies (LST) and practices play a crucial role in releasing poor rural women of all ages from unpaid time burdens so that they have more time for productive work and to participate in development opportunities (Bishop-Sambrook, 2016) [1].

The Lao Upland Rural Advisory Service (LURAS) Phase II supports inclusive agricultural value chains. This includes a 'Green Extension' strategy, a part of which encourages farmers to analyse problems and opportunities, and test alternatives. This study supports that aim through a review of options for LST. In addition to the need to reduce work time and effort, the review considers how adoption of LST will be subject to a range of other influences.

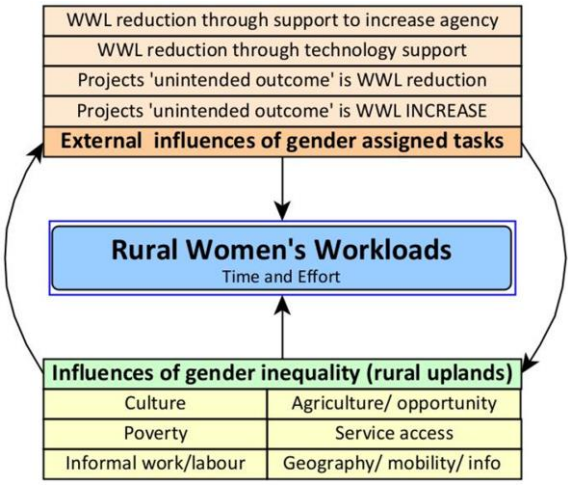
The Lao Uplands Rural Advisory Services (LURAS) project is a program of the Swiss Agency for Development and Cooperation (SDC) and the Government of Laos, implemented by Helvetas in partnership with the Department of Technical Extension and Agro-Processing (DTEAP).

2.2 Methodology

The review of LST and influencing factors has been primarily a desk-based study, using online resources (including the Laofab repository and the LURAS *Laowomen.org* website). Where relevant, organisations in Laos involved with gender/agriculture were approached and invited to contribute experience with regard to LST. The consultant also drew on his direct programmatic experience in Laos.

3. Factors that influence rural women's workloads in Laos

Figure 1. Key workload Influences



Women and girls carry out the bulk of unpaid domestic work. The work typically involves water and fuel collection; food processing, preparation and cooking; travelling and transporting; and caregiving. It is laborious and time-consuming in many rural areas where there is no or limited access to essential public services and labour-saving technologies. Coupled with women's often unpaid role in subsistence farming, this means rural women spend a larger proportion of the day on unpaid and undervalued tasks than men. This can restrict the income they bring in and have control over, their mobility and voice, and the health and nutrition of the whole family (Bishop-Sambrook, 2016).

Factors that can influence the workloads of women in smallholder farming communities are reviewed below. For example, culture, poverty and existing practices all influence gender norms and inequalities, impacting women's roles and their agency (voice, participation, capacity, aspiration), control and decision-making regarding work expectations and division of labour. External factors can further impact gender-assigned tasks through influence over women's agency, access to skills and information, changes in work tasks, and smallholder production methods.

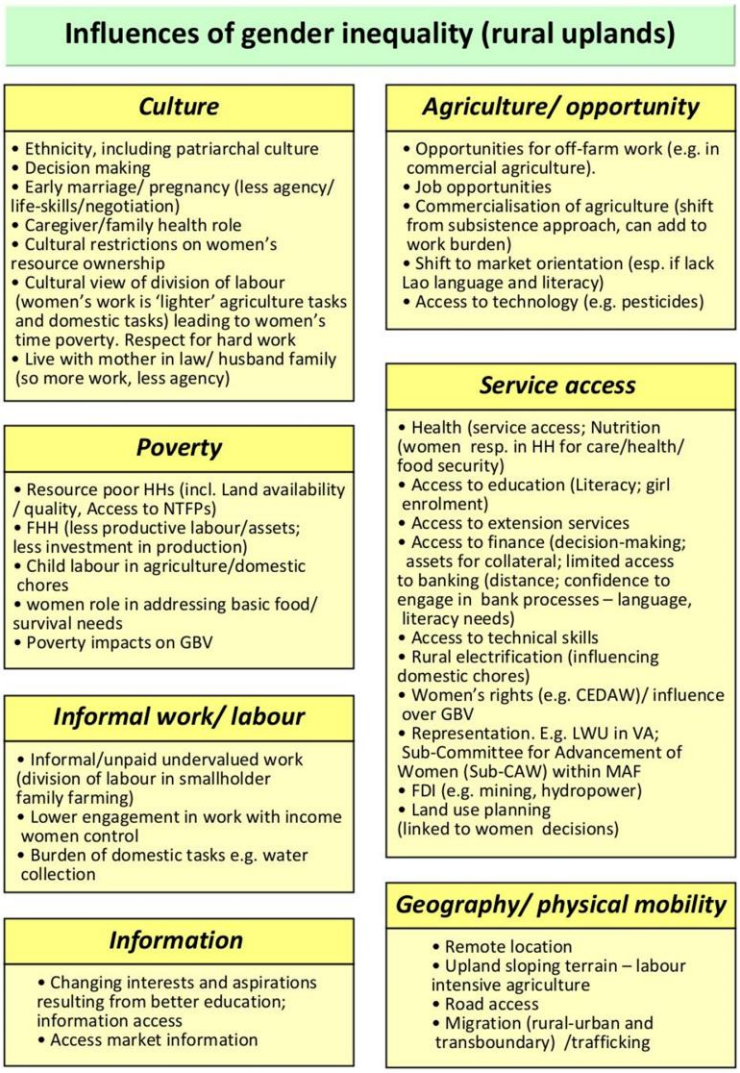
Key workload influences regarding gender inequality and gender-assigned tasks are summarised in Figure 1. This is expanded/explored in more detail in Annex 1. It is hypothesised that positive changes and influences regarding gender equality and gender assigned tasks will positively influence change in rural women's workloads.

The nature of rural women's work in the Northern uplands is a key factor to better understand the issue of workload burden and approaches to support reduction. There are barriers and enablers to women using LST as well as approaches that can support adoption of LST.

3.1 Influences of gender inequality in rural uplands.

Annex 2 provides a narrative on gender issues identified in key documents reviewed, including the World Bank gender assessment, the FAO country gender assessment and the LWU gender profile. Figure 2 summarizes the key influencing factors identified through this review.

Figure 2. Influences of gender inequality (in rural uplands)



These findings are categorised under 7 key areas of influence (noting that there are different ways to categorise, and some degree of cross-over). Culture is a very significant influence of gender norms, with dominant patriarchal ethnicities impacting agency through early marriage, division of labour, and household status. Poverty is also a key influence, where resource access, roles in addressing survival needs and food security, child labour expectations (reducing education access) and the link between low income and conflict/GBV all contribute to inequality. It is recognised that women provide considerable informal and unvalued work and unpaid domestic work. This in turn means less income generation by women which influences control over financial resources and decision making. A lack of physical mobility can also contribute to this, where women in remote uplands have less market access, information access and training. Meanwhile, increasing mobility can result in labour options in commercial agriculture as well as migration (with gender-related risks). Improvements in education and information are leading to increased aspirations for young women (for them and their children outside of traditional upland smallholder agriculture).

Agriculture is shifting from smallholder subsistence to commercial farming which influences gender through increased work opportunities, in some cases including off-farm work, but also increased work burden for women where tasks are added to their workload. Increasing market orientation can also negatively impact women if they lack language skills, education and the confidence to engage. Service access has an underlying influence on gender as this influences women's engagement in care/health food security roles as well as understanding legal rights (e.g. regarding GBV).

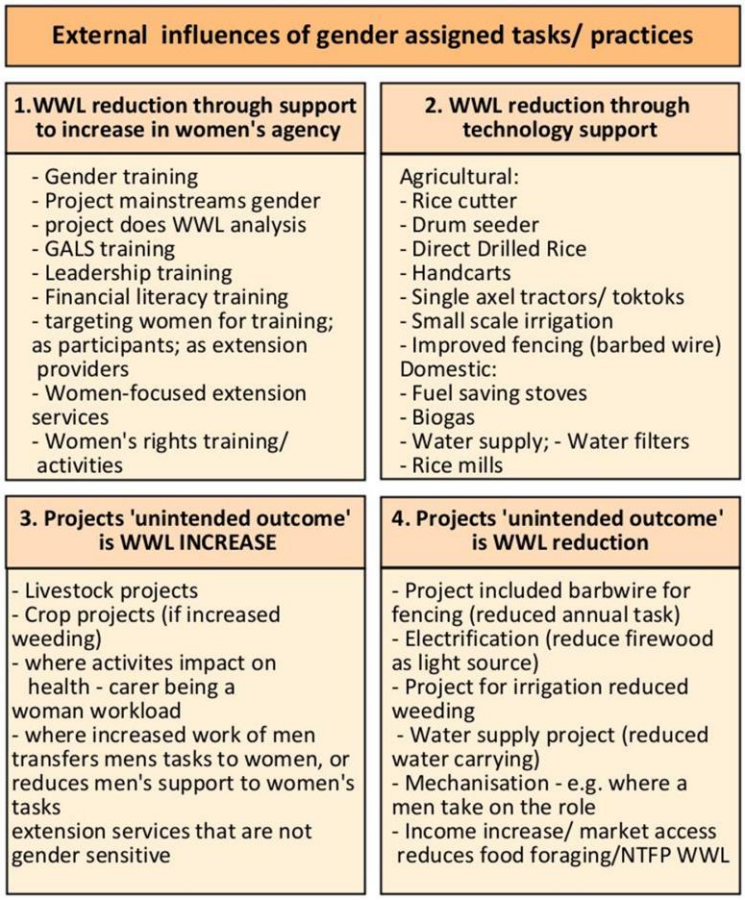
Positive elements or positive changes in relation to *key influences of gender inequality* will increase women's agency (voice, participation, capacity, aspiration), and influence family/husband attitudes and divisions of labour, supporting positive changes to women's workload and quality of life.

The introduction of LST should be considered in relation to these key influences.

(E.g. consider whether women will be supported to adopt the LST? Will they have access to training and information? Will men take on mechanised tasks displacing women to other labour-intensive tasks?

3.2 External/project influences over gender assigned tasks

Figure 3. External influences on gender assigned tasks



In addition to the influences of gender inequality reviewed above, further influences of assignment to rural upland tasks according to gender can be considered. Figure 3 identifies 4 key areas of external influence, where interventions are design to (1) address gender inequalities and women's agency, including division of labour, and therefore impact women's workload positively, and where (2) specific LSTs are introduced to reduce the burden of specific tasks. Meanwhile, it should be recognised that not all projects, interventions and external influence has a gender-sensitive focus and inevitably some actions will inadvertently (unintended) increase women's workloads (box 3), by positively providing assets and income generation options but also the additional work that accompanies this. Finally, some activities or inputs will reduce the work burden of specific tasks, although this may not have been the primarily objective. Water supply is a common example where the focus of provision is often health, rather than workload reduction.

It can be argued that introducing an LST technology should not be done without consideration of the other influences on gender assigned tasks, for example supporting the LST with programming to increase women's agency. LST (as will be discussed below) may not have the impact for women as expected if other gender issues in the household and community are not reviewed, understood and addressed. Meanwhile, agricultural projects often implement several activities, and time saved from workload reduction in one labour-based activity may simply be transferred to a different labour requirement.

As with the key influences on gender inequality, positive changes in relation to the *influences of gender assigned tasks* will impact on the success of the LST in providing genuine reductions in the time and labour effort of rural women. Conversely, LST introduced without consideration of these factors may limit or negatively impact women's workload reduction.

The introduction of LST should be considered in relation to these key influences.

3.3 Rural women's work

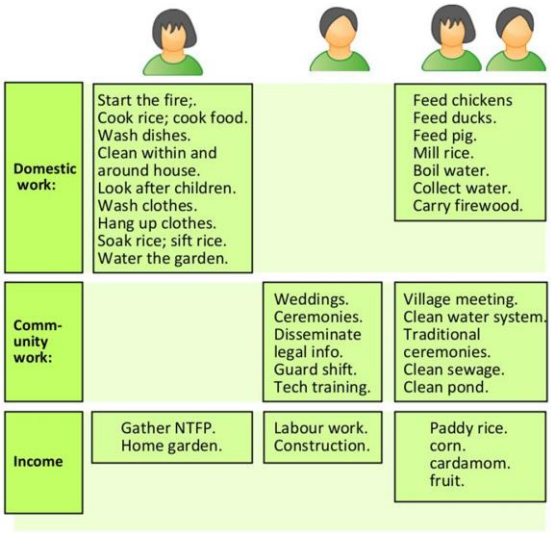
The '*Laowomen'* project[2] (under LURAS) studied 9 rural women over a 1-year period. Three categories of **work task** were identified: women's domestic work, women's farm-work and women's IGA. Further observations of rural women workload (LURAS) include[3]:

- Women provide most of the labour for growing crops (usually, men only help out at the beginning of the growing season by participating in crop planting).
- Women spend most of their time in the fields. Many sleep in the fields because it is too far to return home every night.
- Extended families have a larger pool of labour that enables them to earn more money by growing crops. Larger families also have more females to share the women's workload.
- Poor, female-headed households are more vulnerable than male-headed households.
- When outside work is available, the women often work as hired hands to gain extra income for their families.
- Women rely on men to take them to the market to sell produce because most cannot ride motorbikes.
- Villagers see the importance of education and keep their children in school as long as possible. However, this also means that women receive less help with household chores and work in the fields.

Figure 4. Women's workload tasks (based on 'laowomen.org')

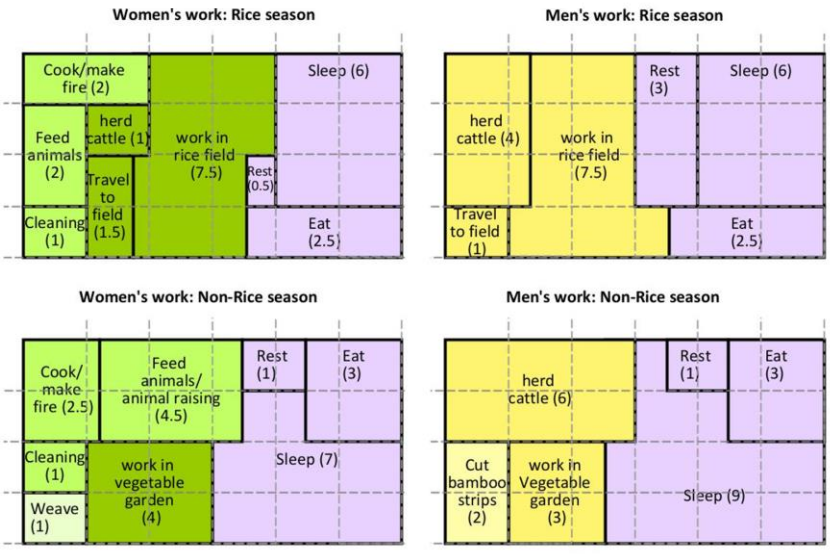
Women's domestic work:	Women's farm work:	Women IGA
All housework: cooking; cleaning	Working in the fields	collecting forest products
Feeding animals	Other labour for growing crops	weaving
collect & chop firewood		
child-rearing		
collecting water		

Figure 5. Division of labour (Laowomen study, Konkaen)



The study also reviewed the **division of labour** in Konkaen village (shown in figure 5). It is notable that women do not have specific community work (only when done together with men), and conversely, men do not have specific domestic work tasks.

Figure 6. Division of labour (based on FAO data)



FAO (2019)[4] reviewed the division of labour in Ban Nason, Phaxai district, Xieng Khouang (Northern upland village). Figure 6 has been developed by extracting data from the FAO review to show relative worktime of the 24-hour period (4x6 grid = 24 hours). It can be seen that in the non-rice season, women's rice field work tasks primarily transfer to livestock raising and vegetable growing. Meanwhile, men's non-rice season tasks include vegetable growing to a lesser extent, with the time they spend herding cattle increasing significantly. In both scenarios women have less non-work (eat/rest/sleep) time, significantly so in the rice season. The LWU analysis[5] (LWU, 2018) is similar, noting that women do most of the farm work (planting, weeding and harvesting crops), tending livestock, and also spend long hours performing off-farm and household chores such as collecting firewood, preparing meals and caring for children.

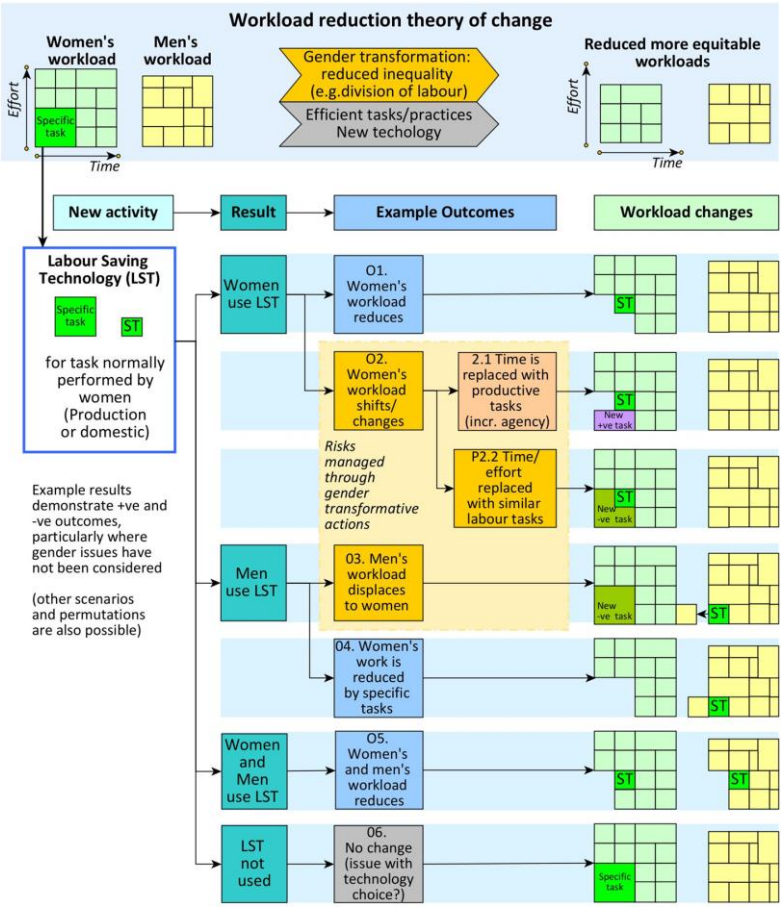
3.4 Women's workload reduction – Adoption of LST

3.4.1 Adoption of labour-saving technology (LST)

Grassi et al (2015)[6] notes that smallholder women's access to resources is very diversified and context related. However, research indicates that in comparison with men, women bear a disproportionate work burden which leads to **time poverty.** Women have limited access to solutions in the form of labour-saving technologies, services and infrastructure, and in many regions, they also face mobility constraints. Grassi notes that rural women's long working hours correlate to a triple work burden in the **productive, reproductive and social spheres,** and in contrast to men their work is mostly unpaid and unrecognized. This work overload restricts women's well-being and their engagement in activities of value, including remunerative activities. There are no "quick fixes", such as the mere introduction and diffusion of technology with labour-saving potential. The issues surrounding the lack of access to and adoption of technology are context-specific and complex. **Social norms** and behaviour need to be targeted for change to take place and for greater equality to be achieved between men and women in relation to time availability and choice. Women's technology adoption rate is particularly low. Ragasa's literature research and synthesis of 35 case studies (2012, cited in Grassi 2015) concludes that low adoption is mostly due to women's limited access to complementary inputs and services. Peterman, Behrman and Quisumbing (2010, cited in Grassi 2015) further explain that it is the "accessibility of inputs, not propensity to use inputs" that constitutes a major bottleneck for many women farmers.

3.4.2 LST Theory of change

Figure 7. Workload reduction theory of change



The challenges of LST adoption are considered in this ToC diagram. It is hypothesised that the application of gender transformation and new practices/LST to inequitable workloads will result in reduced more equitable workloads.

In the example, an LST is introduced that cuts a specific task by 75%. In outcome 1, the women use the LST and a work reduction is reflected in the workload change. However, in outcome 2, the result is a shift in workload where the reduced time is reallocated to other labour work, or perhaps work that is more productive. In outcome 3, men take on the LST (more likely in non-domestic/ machinery focused LST). In this case not only is the time saved by the women replaced by another labour task, but some of the men's work also shifts to women as men take on the LST task. Alternatively, perhaps less likely, the task simply shifts to men and women see a workload reduction. The final scenarios proposed are that the benefit is shared (05) or that the LST is not adopted (O6) and there is no impact.

This model is proposing that negative consequence of LST introduction should be anticipated and that introduction of new practices (LST) should be coupled with gender transformative activities (the orange box from outcomes 2 and 3). Also note that LST often addresses symptoms but not causes of high WWLs. Time saved for a specific task may not translate as time saved over the working day.

3.4.3 LST - Barriers and Enablers

Barriers to the adoption of LST can be reduced through the application of gender transformative actions to increase women's agency in terms of division of labour, decision making, and engagement in productive work. Barriers and enablers are summarized below, based on Grassi (2015) and Bishop-Sambrook (2016)). A detailed review is annexed.

Table 1 Barriers to adoption of LST by Women

Barriers	Description
Education:	Rural women's low education and literacy levels affect their capacity to make informed choices.
Access to inputs:	A lack of access to LST inputs and services and ability to use them (affected by social norms, cultural practices, lack of education) such as credit, fertilizer, and information
Men and technology:	Gender norms about men's control of technology, information, and knowledge can limit women's opportunities to learn, use and benefit from technologies.
Household dynamics:	Men may not invest in technologies when women can do the work for free. They often appropriate women's technologies because they attribute a social importance to it, or there is IGA potential.
Time availability:	"Time poverty" (absence of discretionary time that women can dedicate to personal interests, paid labour, education, or other endeavours) can include time for learning skills that would allow women to adopt new technologies to improve their productivity or start a small business
Physical challenges:	Most existing agricultural tools and equipment tend to be designed for men's physiques, with the result that they are often too heavy or too high for women to handle comfortably
Unreliability:	LSTs in poor rural areas need to be reliable as remoteness and poor market access and limited financial control can limit repair or replacement (can include local materials and labour in production)
Social norms:	Certain technologies or practices may not be considered suitable for women. Restrictions on mobility and on associating with non-family members pose barriers to women's adoption of new technologies.
Financial and institutional constraints:	Women tend to lack financial resources to use, rent or purchase established and new technologies. Access to credit is restrictive for women's small businesses. A risk with mechanized technologies, is that men can more readily afford and run these, and may not share benefits/ income within the household.
LST Dis-semination strategies:	Dissemination strategies that rely on individual entrepreneurs often put women and poor farmers at a disadvantage. E.g. some rural mills are owned by community organizations or women's groups, most belong to individual male entrepreneurs, restricting access for poor who cannot afford the services.
Underserved by extension:	Women have been underserved by traditional extension owing to childcare responsibilities and the scarcity of free time. Female farmers may not feel comfortable asking questions to male extension agents. Women may feel inhibited to speak freely in groups with men.
Mobility:	Women often cannot travel long distances to attend extension sessions owing to time, cost and childcare/household responsibilities, as well as restrictions due to cultural norms.
Visibility of women farmers:	Women's productive work is not visible/targeted by extension; advice is not tailored to needs. Often women are not considered the smallholder decision-maker and not approached by male extension agents. Extension is given to men even for tasks managed by women, assuming info will be shared.
Information:	Culturally women's role does not include attending meetings/community information dissemination (as it is a male head of household role). This needs consideration when training women or targeting them in activities. Lack of access to ICT or mobile phones restricts women's ability to access information
ICT:	Can improve access to markets, supply chain management and information inputs/ services (supports LST uptake). The gender digital divide (ownership; independent access to IT/phones) is still wide.

Table 2. Enablers to support LST uptake

Enablers	Description
Gender/ socio-economic analysis	***Gender analysis:*** is required to ensure interventions do not inadvertently increase the labour and/or resources required, or undermine work valued by women. Gender strategies should work with men as well as women and can sensitize project beneficiaries to the concerns and needs of both. LSTs need to bring advantages that are valued by heads of households (who are often men).
Gender trans-formation	***Gender interventions:*** Stimulate behaviour change (men and women) regarding gender norms that drive inequalities and hinder growth. Engage women and men to reduce WWL. Strengthen women's voice to influence HH expenditure, joint-decision making and sharing of tasks over time (methods include self-

	help groups; gender-sensitive participatory field tools. Women often choose socially acceptable technologies, and men allow women to adopt then as long as their "power" is not fully challenged. ***Community sensitization*** on the issue of equitable workloads and their impact on rural livelihoods. (Advocacy on gender/LST can also be undertaken at national levels). ***Capacity:*** Increasing women's autonomy to decide about technology needs and use. ***Equal ownership***: and /or control over key productive assets allows planning of technology uptake, including women membership/participation in local associations and cooperatives that provide the social structure, means and skills to improve and diversify agricultural production.
LST design	***Gender inclusion:*** Men need to be engaged in project design (refers both to men's greater time availability in relation to women and to their role in women's access to and adoption of technology). ***User inclusion:*** LSTs are compromised when perceptions are not shared by both the project and beneficiaries. LSTs developed by local artisans/manufacturers in consultation with women (applying indigenous knowledge and experience of tasks) are more likely to be appropriate in women's lives. They can also be rejected if the taste, smell or colour of the "new" product (e.g. water or cooked food) is different or off-putting. Traditional practices and beliefs may play a part in acceptability. ***Design:*** slowly progress up a ladder of technologies (which becomes increasingly complex but also more effective) in line with financial, operational and management capabilities.
Collective action	Can enable women (as well as men) to take advantage of technologies and services. E.g. collective ownership of rice mills; women's self-help groups (can support entrepreneurship, financing, marketing)
Energy	Energy is a critical input for women's productive and reproductive work. Inefficient sources of energy are major causes of time poverty for women and girls.
Water efficiency	Irrigation projects can provide water for crop/vegetable production, animal watering, domestic tasks and reduce water collection time of women (multi-use, multi-user and multi-purpose water systems).
Feeder and main roads	Can greatly reduce women's time burden and expand their work opportunities, especially when combined with accessible and affordable modes of transportation.
Consultation	Women should be empowered through participatory technology development that seeks to incorporate their perspective so that they are able to help themselves.
Added value	The LST may also be an IGA (e.g. food processing mills). This can also promote more equitable roles, attracting men to domestic tasks which can become profitable.
Policy	FAO consider the enabling environment includes policy that supports gender-sensitive technology.
Existing practices	LSTs have better adoption if easy and convenient to use by women. E.g. fuel-efficient stoves that support cooking habits rather than require a change in cooking habits.

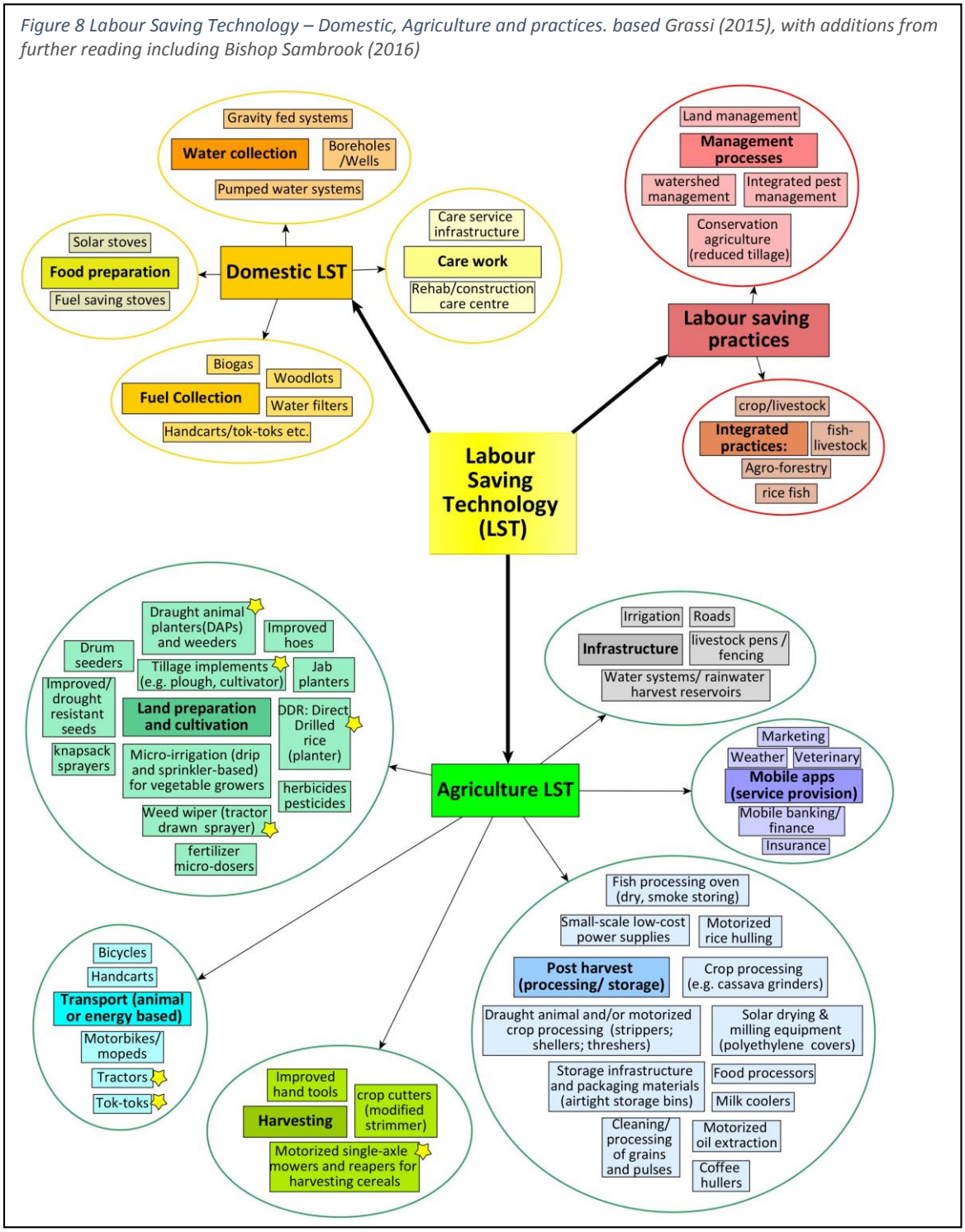
3.4.4 Process for selection/implementation of LSTs (Bishop-Sambrook, 2016).

- **Identification:** Identifying workloads through gender-sensitive participatory approaches, so voices of diverse groups are heard, to help understand the time poverty of women, men, youth and children in daily life.
- **Design:** Selection of technologies and practices. Gender-sensitive participatory tools are used to listen to technology preferences and aspirations of different members of communities. They also support to integrate local customs and knowledge , thereby promoting interest and local ownership.
- **Implementation:** Delivering LST should include facilitating women's participation in design, planning, siting, construction, operation, maintenance, management and monitoring. It is essential that they have real choices for LST to be adopted and sustained. Training should be at times/locations convenient for women's participation. Mapping a sustainability framework can help to ensure opportunities for improving women's daily lives.
- **O&M:** The breakdown, inability to repair, and time to get spares increases the risk of returning to original practices. Training women in maintenance/repair can keep LSTs in operation and may provide income. For more complex LSTs, communities need to be aware of external support. If LSTs are manufactured locally, spares are likely to be available. It is important to establish which stakeholders are financially responsible for which costs, and over what period of time. Consider capital costs, O&M costs, ability and willingness to pay. These are important when women lack access to cash and male heads of households are reluctant to contribute.

4 Labour-Saving Technology (LST)

Bishop-Sambrook defines labour-saving agricultural technologies as "tools and equipment which reduce the drudgery and/or improve the efficiency of performing various farming or household activities". A recent brief by FAO (2019) on LST[7] notes that technologies that address specific labour constraints (reduce time and effort for specific tasks) should also be women-friendly (WF). LST options proposed by Grassi et al (2015) (and others) are shown in the diagram below) (also see annex 6). LST with a yellow star may be considered less women-friendly (e.g. where men are more likely to operate larger machinery with a risk of women's work transferred to other labour tasks, rather than reduced).

Figure 8 Labour Saving Technology – Domestic, Agriculture and practices. based Grassi (2015), with additions from further reading including Bishop Sambrook (2016)

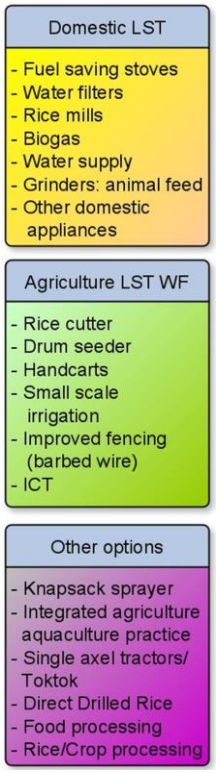


5 Labour-Saving Technology (LST) options for rural/upland Laos

5.1 'Menu' of options

The following is an initial menu of options for consideration in LURAS target communities (figure 9), including a summary of WWL reduction. A detailed review of each option is annexed. This brief review of LST will not capture all examples from Laos; it is possible that as LURAS takes this discussion forward more options come to light (from implementing stakeholders, communities and rural women) and the review can be updated accordingly.

Figure 9. Menu of options



5.1.1 Domestic workload reduction

The *laowomen* research of upland communities suggests men do not have specific domestic tasks. This implies that LST in the domestic sphere are more likely to be used by women and translate into actual workload reduction rather than shifting the saved time and effort to a different task.

D1.Fuel saving stoves	Bucket-sized clay pots, often in a metal casing, with a vent for air and fuel insertion near the base, and a ceramic or metal grate, that increases efficiency of fossil fuel cooking (compared to open fire cooking). 
WL reduction	***Effort:*** Reduce effort for fuel collection (and reduces fuel resource needs). ***Time:*** Reduces time to collect fuel/wood. Can reduce cooking time.
Use in Laos	Ceramic stoves are common across Laos. Of note SNV have promoted an improved cook stove and an Advanced Biomass Cookstove (ABC) (also for fume reduction). Civitas are distributing higher quality stoves linked to carbon credits (see annex).
Comments	Where there is no electricity, open fires are used for cooking, heat and as a key source of household light/family socialisation. This may impact uptake of fuel saving stoves. Lower quality stoves may break within 1 year. The design is suitable in northern Laos where wood rather than charcoal is the normal cooking fuel.

D2. Rice mills	***Motorised rice mills:*** An engine (similar to a small tok-tok engine) on a frame connected by a belt to a funnelled mechanism into which unhusked rice is poured, and husked rice and chaff are separated. ***Water powered rice mills:*** Water is piped to a large balanced pestle and mortar. A cavity in the end of the hinged pestle fills with water pushing it down, until the angle is such that the water pours out. As it returns, the other end falls into the mortar and pounds the rice. 
WL reduction	***Effort:*** Reduces the considerable effort required to pound rice by hand. ***Time:*** Increases the rate at which unhusked rice can be husked and used in cooking. Some report manual husking for a family can take up to 4 hours/day.
Use in Laos	Widely used; Both used in Dak Cheung, Sekong, with upland communities
Comments	Chaff (rice husks) is used as pig food. Risks for water powered mills include leaving rice unsupervised during the day (can be eaten by animals or taken). Requires good gender transformation approach/women group management.

D3. Water filters	Ceramic pots (also known as rabbit filters in Cambodia) that filter water to a lower container to reduce pathogens (are manufactured in Pakse, Southern Laos). 
WL reduction	***Effort:*** Reduces time/effort for firewood collection and boiling water. ***Time:*** Reduction in Diarrhoea disease (impact in terms of working days lost to illness).
Use in Laos	Various projects/organisations have used them including SFE; SNV; CARE; BEQUAL
Comments	Filters eventually require replacement (bringing issues of ease of supply of replacement to remote areas, as well as cost – one set is 450,000LAK)[9]

D4. Biogas	Latrine, with large domed pit to the side (often with a further opening to add animal waste). Methane gas from the breakdown of waste accumulates in the dome and can be used as an energy source for cooking and light.
WL reduction	***Effort:*** Reduces cooking fuel needs and therefore reduces labour to collect fuel/wood. ***Time:*** saved in fuel collection and starting/lighting fire stoves.
Use in Laos	SNV piloted biogas in 2007. Challenges for uptake related to regular latrine use and livestock being free range, limiting composting material availability.
Comments	Requires good set up and correct fittings/ management to manage risks related to gas leaks. Changes in latrine use and stalling livestock (cattle/pigs) may make biogas a more viable option. Other processing waste such as coffee husks can also be considered a biomass option (SNV maybe interested to pilot biogas from coffee waste; noting that they currently have technical staff with experience for this).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D5. Water supply	Can be gravity fed systems with taps; boreholes; protected dug wells (protected source) (health); well-buried pipes (longevity). WWL impact needs women consultation in design
WL reduction	***Effort/time:*** Reduces labour/time needed to fetch water, primarily a women's task.
Use in Laos	GFS are widely used in upland areas (Designs can be made to be women friendly).
Comments	Water close to homes can reduce social element of collection for women. Safe water measures include proper construction, use of a protected source (e.g. spring); avoiding chemical intrusion into water; water quality: faecal contamination: arsenic; nitrates; etc.

D6. Grinding: livestock feed	Small motorised machine (similar to rice mill: engine or motor and funnelled processing attachment) can be used to grind animal feed (e.g. grinding cassava for pig food).
WL reduction	Can reduce time and effort in feed preparation for domestic livestock (the role of women).
Use in Laos	Available in larger provincial markets e.g. Pakse; Vientiane. Used by women in Sekong.

D7. Other appliances	Electrification enables a multitude of domestic appliances to reduce workload. Examples include electric cooking pots/fryers; rice steamers; washing machines; blenders. Can also support IGA in some cases.
WL reduction	Can reduce time and effort in domestic chores: cooking, cleaning, washing clothes.
Use in Laos	Available in markets where there is electrification *(similar to D3 (filters) re. decision/ costs for replacement)*

5.1.2 Agricultural workload reduction

The following are identified as options in Laos that can be considered 'women-friendly'. There remains a risk that men may take over the task, displacing women to other labour tasks, if introduced without a gender-sensitive process.

A1. Rice cutter	Modified bush cutter/ strimmer (with circular blade and wind-rower (fitting above blade to push the straw to the side in rows).
WL reduction	***Effort:*** Replaces manual harvesting labour, prominently a women's task. ***Time:*** Increased harvest speed (up to 7.8x see annex)
Use in Laos	Is used in Laos, e.g. Xieng Khouang (see Laofab you-tube)[11]
Comments	May result in reassignment of women to other manual labour if men use the rice cutter. Women can use strimmers (lightweight strimmers are available) and so approach can focus on women as users.

A2. Drum seeder	Manually pulled plastic drums on 2-wheel axel, for seeding pre-germinated rice
WL reduction	***Effort:*** Replaces manual transplanting which is primarily a women's task. ***Time:*** Can address labour scarcity for smallholder rice farmers during planting.
Use in Laos	FAO have trialled and studied this option in Sayabouli (see annex).
Comments	It may reduce casual labour work options (transplanting) for women.

The 12-row drum seeder used by farmers in Sayabouly province

A3. Handcarts	Pushed wooden handcart; two-wheels (similar to motorbike's pneumatic tyres).
WL reduction	***Effort:*** reduces physical exertion of numerous tasks, including wood collection; water collection; harvesting NTFP and crops. ***Time:*** Reduces transport time (many more trips needed when items are carried by back – see annex).

Use in Laos	Used widely. CARE promoted these in Sekong province. SNV in Houaphan.
Comments	Men will also use handcarts. Utility of handcart is also impacted by road access (e.g. may need to carry wood ½ way to the roadside; the handcart is then used to complete the trip).

A4. Irrigation	***Small scale irrigation:*** Structure to divert perennial water source to fields via small canals or pipes (can also use water wheels).
WL reduction	***Effort:*** Reduces weeding (primarily a women's task). Can reduce water collection for livestock/ some domestic tasks. ***Time:*** Reduces weeding & water carrying
Use in Laos	Numerous projects.

A5. Fencing	**Barbwire** with sufficient strands to prevent livestock entering crop fields
WL reduction	***Effort:*** Can reduce labour for construction/maintenance of wooden cattle-proof fencing in steep upland slopes. ***Time:*** Reduces annual fencing tasks in upland fields.
Use in Laos	Used in upland communities in Sekong (women's group request) to reduce annual fence repair/ construction. Some documents suggest this is a male task, so this requires assessment before promoted.

A6. ICT Phone/ apps	Mobile phones to support marketing, accessing information, accessing financial services (can be via a local banking agent).
WL reduction	***Effort:*** Knowledge of weather can reduce risks in untimely planting resulting in replanting if late rains; can access info on livestock disease and take steps to manage the risk. ***Time:*** Reduces time traveling to bank services; time visiting marketing stakeholders (e.g. traders) directly.
Use in Laos	BCOME mobile transactions through agents are being rolled out by BCEL; marketing and weather/farmer app specific to Laos are not identified in this study. Weather/market data is available online via phones.
Comments	There may be potential to use existing apps or ones used regionally. Women can be made aware of apps/ info on their phone that supports farming decision making; and of BCOME agent locations/function.

5.1.3 Other options (less women friendly/ or not 'stand-alone' interventions for WWL reduction)

The following are labour saving devices/approaches available in Laos. In the case of the hand tractor and DDR drill they are unlikely to be used by women. DDR may have limited application in uplands. IAA is an option but requires careful management of workload dynamics; use of pesticides in the water is a risk to fish. Use of knapsacks greatly reduces weeding labour tasks, but also involves use of herbicide/pesticide which need to be part of a technical program instructing safe and correct use and storage and ensuring full safety measures are taken.

1. Knapsack sprayer	knapsack tank (9-23litres) with pressurizing device, line, and sprayer nozzle. Should be < 25kg when full[12].
WL reduction	***Effort:*** Reduces 'head down' labour -hand-weeding. ***Time:*** Herbicide reduces weeding time by 88-97%[13]
Use in Laos	Upland spraying is often via water pump/ hoses (commonly men control spray; women move the hoses)
Comments	Need good technical knowledge and safety management (re herbicides and pesticides) linked to crop activity (difficult then as a stand-alone WWL LST).

2. IAA	***Integrated agriculture aquaculture***: Raising fish/fingerling in paddy fields
WL reduction	***Effort:*** Can reduce effort related to acquiring protein-based food sources or NTFP foods. ***Time:*** can contribute to reducing time spent weeding and applying pesticides as the fish feed on the weeds, reduce pests and simultaneously fertilize the rice
Use in Laos	It is a traditional practice. Extent of current practice is not clear from initial review.
Comments	Additional production (protein) from the rice fields can support both income and nutrition). Managing fish can add an extra workload role for women. Fingerlings are an annual cost as water is not perennial.

3. DDR	Hand-tractor pulled Direct Drilled Rice machine. Drills seed 10-15cm in paddy.
WL reduction	***Effort:*** Replaces manual transplanting which is primarily a women's task. ***Time:*** Can address labour scarcity for smallholder farmers during planting.
Use in Laos	Increasingly used in low land paddy in Savannakhet; Saysomboun, etc.
Comments	Most likely to be used by men. Risk of WWL transferred to other labour activity needs considering.

4.Single axel tractor	4 to 15 kW hand tractor /tok-tok controlled by the operator walking behind it or used to tow a trailer (see picture). 
WL reduction	***Effort/Time:*** Reduces strenuous carrying tasks; transport; pull seed drills/ rotovator. Transport wood, farm products and people from the field to market. *(**Moped**s can also perform this role in part and therefore are also LST)*
Use in Laos	They are found in all villages. Less common in poor households.
Comments	Often it will be men to use the tok-tok. Workload reduction for tilling will impact on men more than women. Gender approaches can be used to encourage tok-tok use that supports/reduces WWL tasks.

5. Food processing	Domestic use: Seasonal foods processed (e.g. jam) when fruit or food is more easily available and can be stored for use in the off season.
WL reduction	***Effort:*** Reduces effort of carrying NFTPs to the HH in the off-season (but processing is additional work). ***Time:*** Reduces time to find other foods e.g. NTFPs in the off season
Use in Laos	Xaoban[14]is a local company selling processed products (yogurt; jam, honey) supporting remote villagers to sell products. However, the focus (from website) is more IGA than WWL reduction (IGA in itself can increase agency and therefore may impact time efficiency and life quality, but IGA is not directly an LST).
Comments	ADRA began this as a WWL action in new programming in Xieng Khouang (too early for results).

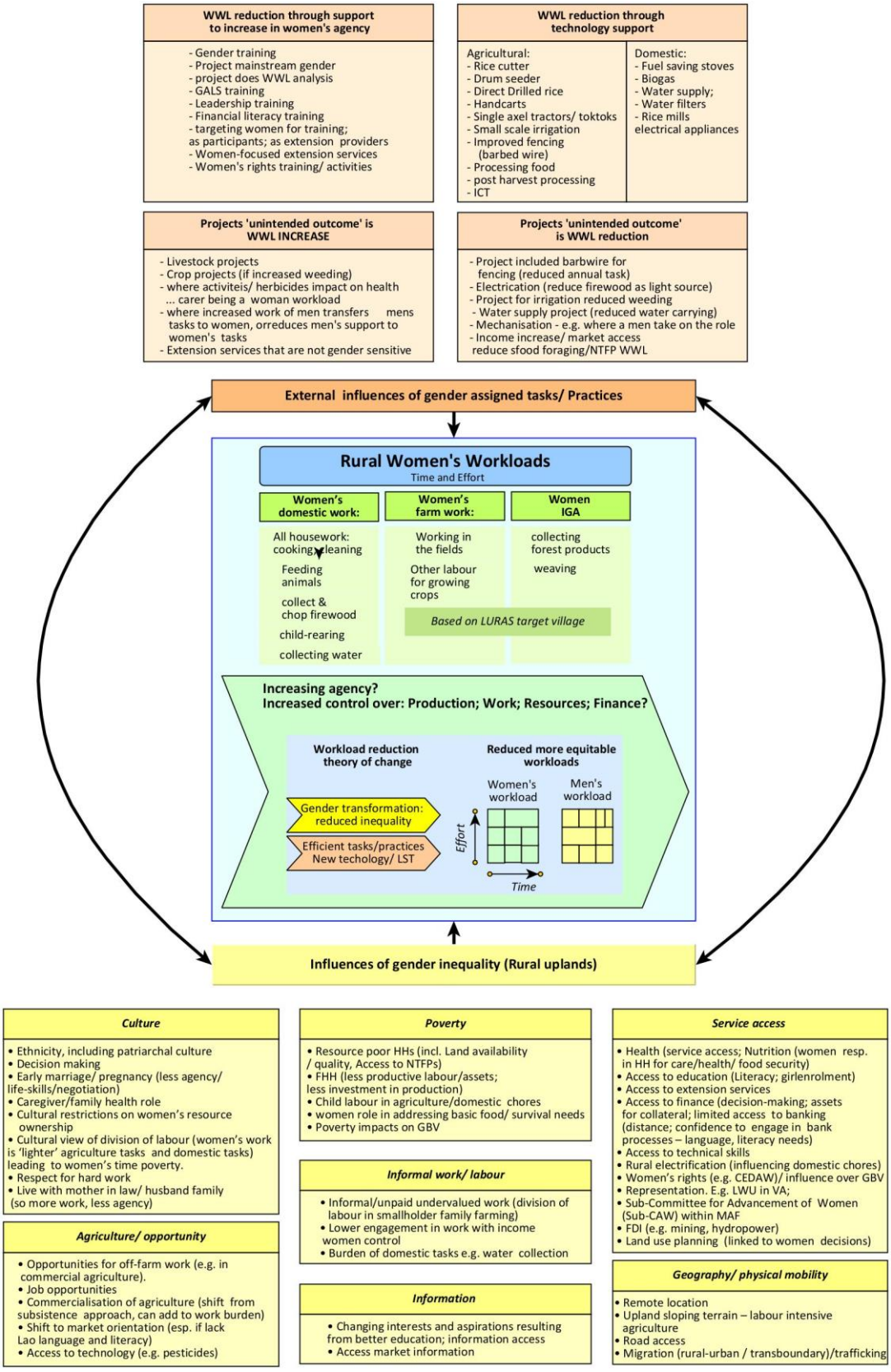
6. Rice/Crop processing	Agriculture: Mechanisation with: planting; transplanting; weed management; using herbicide/ fertilizer; harvesting; drying rice; threshing; milling; grinding feed are available (see Anyoni, O. (2017)).[15]
Comments	As with DDR, machines are likely to be used by men, with the risk of WWL transfer to other labour.

6 Recommendations for further study

- Time efficiency study (Household level) before and after the distribution of LSTs.
  - Include comparison between Agriculture and Domestic LST receiving HHs (before and after LST) and the reassignment of saved time. Study similar households who receive either a domestic or agricultural LST)
  - The notion that LST to reduce WWL will often attract male adoption of the technology/role, and displace women to other labour-tasks is hypothesises in a number of LST reviews. The study should consider if domestic focused LST has greater impact on WWL (as male adoption is either less likely or will have less displacement, as most/all domestic work is already done by women) than agricultural LST.
- Study to review how LST impacts on women's income opportunities and their agency.
  - Saved time may transfer to IGAs, and increased financial management/decisions
  - FAO's Drum seeder research hypothesises LST reduced women's income opportunities from labour
  - Some LST can also be an IGA (e.g. where food is processed; machinery/operation can be hired to neighbouring farmers) and directly link to increased agency.
- Review market availability (supply) of 'trialled' LST and other LST to upland villagers (e.g. how easily can a farmer buy a drum seeder after seeing trials via DAFO; can upland villages find/buy/afford water filters; ABC stoves etc).
- Review of ICT options in upland communities, and approaches to increase ICT access.
  - Consider locally/regionally available apps or useful websites that are in/easily translate to Laos (NAFRI?).
  - Review with farmers/women how and if they might use apps (access does not necessarily mean use).
- Further study of the factors that influence adoption of specific LSTs
  - Influencing factors are listed in the first chapter. However, what is the weighting/relative significance?
  - What are the key barriers to LST adoption in target areas; how can these be addressed?
  - Understand willingness to adopt certain LST over others (context, gender-specific priorities/restrictions)
- Cooking with electricity will have more WWL reduction than stoves (no fuel collection). The barriers to this transition should be reviewed in term of culture (communal/group food preparation/cooking/eating/socialising) as well as technology (affordable electric cooking as rural villages gain electrification)].
- Biogas pilot using coffee huller waste (SNV seem interested in piloting this).
- Biogas pilot where latrine use is established /used, and livestock are stalled (e.g. raising pigs; stalled cattle).

Annex

Annex 1. Mapping of influences of rural women's work



Annex 2. Literature review of Rural Women's work

2.1 Gender in Laos (key source: World Bank country gender assessment)

The World Bank gender assessment (2012)[16] notes that there is a need to focus on reducing gender inequality and vulnerability in remote rural areas that are home to smaller ethnic groups. Services improvements were noted, while imbalances in health and education included a high Maternal Mortality Rate (MMR), early marriage and pregnancy, and fewer girls enrolled than boys at all levels in school. WASH access varies greatly depending on location, with people in more remote and poorer areas having the least access, and the burden of water collection falling heavily on women and girls. Women are also generally responsible for family health, hygiene and food security. Although their work is largely informal, 73% of women (78% men) contribute to the country's labour force. Women and girls constitute over 70% of unpaid family workers, but only 32% are identified as 'own account workers'. This suggests that women are less likely engaged in productive work with income that they control. Women also report greater difficulty finding access to finance and technical skills. Women's role in agriculture is significant, but often undervalued. Rural areas in Lao PDR are undergoing a period of rapid transformation. Increased agricultural productivity and opportunities for off-farm jobs are helping to pull some households, and selected areas, out of poverty. For women in asset-poor households and areas, including those who have lost access to arable land and lack non-farm skills, the commercialization of agriculture can also increase vulnerability. Shifting from subsistence based to market-oriented household economies can be particularly difficult for women in non-Lao-Tai ethnic groups whose cultural roles, limited Lao language and technical skills, often leave them unprepared to engage with the market. On average, female-headed households have less household labour and productive assets than male-headed households. Both women and men benefit from improved infrastructure. Rural electrification and rural road access particularly help, contributing to close gender gaps by reducing time women spend on domestic chores. Road network improvement is providing better access to services and job opportunities for women and men. But increased road expansion into remote areas also carries new risks for women such as exposure to communicable diseases and human trafficking. Agency, or women's voice and participation, has steadily advanced. Women's rights are recognized in the legal system, and women's political representation in the National Assembly has grown nearly 20% since 1990. It is now among the highest regionally. Women's traditional responsibilities in the household and community as stewards of natural resources position them well to contribute to strategies for adapting to changing environmental realities.

Both gender equality and the equality of all ethnic groups living in Lao PDR are recognised in the Constitution, and in several related laws. The international human rights treaties ratified by Lao PDR include the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), International Covenant on Economic, Social and Cultural Rights (CESCR), Convention on the Elimination of All Forms of Racial Discrimination (CERD) and the Convention on the Rights of the Child (CRC).

The Census of 2005 recognises 49 different ethnic groups belonging to four larger ethno-linguistic groups: Sino – Tibetan, Austro – Asiatic, Hmong – Iumien, and Lao – Tai. Ethnic groups belonging to all four of these ethno-linguistic groups are found in the northern uplands and make up about two-thirds of the northern uplands population, a majority of them live in higher altitude sloping areas, while the Lao – Tai occupy lower lying, flatter areas where paddy cultivation is possible. The northern uplands are characterised by diversity, whether it be social, agro-economic or ecological. The traditional northern uplands system includes the upland plots for rice/vegetable and some maize cultivation (upland rice is always intercropped), use of the forest (for bamboo and timber, for hunting, for NTFPs,), domestic livestock (extensive), rivers and streams (for fish, aquatic animals,), and to a minor extent paddy cultivation. It is observed that poverty is greater for non Lao-Tai ethnic groups, and particularly the women and children. Locally identified poverty includes households with unfavourable dependents to labour ratios; households which has too little land for cultivation and/ or adequate quality; households with no livestock; a household with no investment capital; a household with severe rice shortages (nine months and more). Poor families rely more heavily on forest products for their livelihoods (NTFPs are both an important supplement for incomes, plus an important source of nutrition). (Gerbert, 2009). [17]

Gerbert (2009) further notes that there has been transition from the semi-subsistence livelihood systems to many variations on commercialised agriculture systems. Monocropping can increase women's workload where the weed pressure increases[1], their share of the land clearing work also increases with the increase in brush and shrubs (women's task to clear, men's to cut the larger trees). A coping measure includes herbicides (with related risks) to keep down weed pressure. Commercial crops do not include different kinds of vegetables for home consumption. Women can be disadvantaged in terms of market information. Cash cropping often comes more into the male sphere of dominance, it may impact on women's status in their homes and communities.

2.2 Gender in Laos Agriculture (Key source: FAO Country gender assessment (2019))

Ethnic women and girls are among the most disadvantaged in Lao society (FAO, 2019)[18], facing a heavy burden of work, less decision-making power than men, limited mobility, and cultural norms that limit women's roles in society (Khampoui, 2012, cited in FAO, 2019). Some ethnic cultures (such as the Yao, Hmong, and Akha) have more patriarchal and patrilineal cultures than the Lao-Tai group, which constricts women's role in society and their ownership over land and natural resources (World Bank and ADB, 2012, cited in FAO, 2019). Ethnic communities are thus a priority when it comes to gender interventions, while also presenting the greatest challenges because of deeply rooted cultural norms that disadvantage women. Just over one-third of Lao women marry before aged 18. Remoteness and lack of education contribute to early marriage, as girls may not have other options to advance their futures (FAO, 2019).

In Lao PDR women comprise just over 50 percent of the population economically active in agriculture since at least 1980 (World Bank, 2016, cited in FAO, 2019). However, this high level of women's involvement is not a reliable indicator of women's empowerment in agriculture. The time women spend on agricultural tasks and women's compensation for agricultural work, should be considered, where agricultural work is not always a source of empowerment, and some women may be disempowered and overwhelmed by their agricultural work (FAO, 2019).

Currently, Lao PDR is transitioning from subsistence farming to commercial agriculture, which has brought benefits for some rural communities, including economic growth, poverty reduction and employment, but has exacerbated gender disparities and power imbalances in others. For women in poor rural areas, especially those who have lost access to productive land and who cannot find employment off-farm, commercialization of agriculture can also increase vulnerability. This transition to a market-based economy and the emergence of cash crops can bring particularly negative impacts for non-Lao-Tai ethnic groups, who may not speak or understand Lao language, and who may not have experience in a cash economy. Social safety nets are not yet in place to 'catch' those who may fall during this period of transition. It is also worth noting that not all commercial agriculture is driven by companies or investors. The majority of agricultural production across Southeast Asia (including Lao PDR) is smallholder-driven, with smallholder farmers being "remarkably persistent and surprisingly resilient" in the face of agrarian transformations (Rigg, Salamanca and Thompson, 2015, cited in FAO, 2019). In this context, farmers are also investors, by purchasing inputs, clearing land, transporting, processing, storing and selling agricultural products. When examining agricultural investment at a micro-level, it is also necessary to keep in mind that, on average, female-headed households have less household labour and productive assets than male-headed households (World Bank& ADB, 2012 cited in FAO, 2019).

A predominant issue is chemicals used in commercial agriculture (particularly banana plantations). Significantly, these chemicals are more likely to have severe effects on women's health (including reproductive health) and on children (Xiong and Ling, 2017 cited in FAO, 2019). This is especially the case for migrant workers, often from marginalized ethnic groups, who live and work in dormitories close to the plantations, where exposure to chemicals is highest. LURAS reported in an interview that fertilizers, pesticides, and herbicides often reduce women's workloads by decreasing the amount of time they have to spend on tasks like weeding, while also having the potential to increase their production and incomes. The labour-saving possibilities of pesticides and fertilizers may be a key reason they are

[1] Jim Chamberlain (2006, cited in Gebert 2009) Study of Gender Inequality in Women's Access to Land, Forests and Water in the Nam Ngeum Basin. For ADB TA 4339. In this study Phong women's increase in weeding requirements from around 10 days per season under the traditional system to 56 days.

utilized more by female-headed households, which often lack able-bodied men's labour and thus are more burdened with work (FAO, 2019). FAO identified five key thematic areas relating to gender, agriculture and the rural sector:

Agricultural investment: Land-based investment/FDI (agribusiness, hydropower, mining, infrastructure) has increased rapidly. More smallholder farming families are coming into contact with foreign investors. Yet many communities. and particularly women, are not equipped to negotiate with investors. Commercial agriculture is opening new opportunities for women to undertake paid employment, particularly through participation in 'non-traditional export crop production' (as contract farmers or direct wage employees) (World Bank, 2016, cited in FAO, 2019). Some work has been done to ensure that local-level contracts are fair and transparent, efforts to ensure that women are meaningfully included in contract farming negotiations and benefit equally are still nascent. FAO give an example where men reported cassava contract farming was less labour intensive than rice farming. Women reported that their workload had increased. A potential benefit from agricultural investment for women is opportunities for employment, wages and training. Casual labourers can lead to increased income for families, although it is common for this employment to only come at the beginning of a project during the land clearing and preparation stage (FAO, 2019).

Labour: Seventy-two percent of the population is employed in agriculture, forestry and fishing, and most of this work is on family-run smallholdings. Unpaid family work is concentrated in rural areas. The vast majority of women in rural areas without roads engage in this uncompensated labour (Lao Statistics Bureau, 2015, cited in FAO, 2019).

The 2010 Labour Force Survey and Child Labour Survey found that roughly 15 percent of children aged 5-17 are working (Lao Statistics Bureau and IPEC, 2012, cited in FAO, 2019). Girls comprise 55 percent of the child workforce. The vast majority (90%) work in agriculture, forestry or fishing. Over two-thirds of working children (68%) are unpaid family workers. Outside of economic labour activity, the vast majority of children in Lao PDR contribute to household work, through chores such as washing clothes, cleaning dishes and the house, and cooking.

Traditionally, women have tasks within the private sphere (household, child-rearing, subsistence tasks, etc.), men in the public sphere. The influx of women in income generating labour, due to factors such as increasing agricultural investment, has not lightened the original burdens, creating an unbalanced division of labour in which women carry a triple burden of productive, reproductive and community work, be it paid or, as in most cases, unpaid.

The issue of human trafficking across borders particularly threatens rural communities where opportunities for labour are sparser and where the notion of seeking better work abroad has high appeal.

Division of labour between men and women in agricultural villages varies based on ethnic groups. In general women's work is seen as 'lighter' and men's as 'heavier.' Women are responsible for domestic tasks including taking care of children, cooking and cleaning, as well as feeding small livestock, watering gardens and weeding. Men generally undertake tasks that are more physical, such as repairing household damages, cutting wood, ploughing fields, tending larger livestock and operating machinery. The presence of rigid gender roles in rural societies constrains women's time allocation leads to 'time poverty.' Domestic activities that are time-intensive, such as fetching water and fuel, are generally the women's domain, and are more demanding in areas lacking basic infrastructure such as water and electricity (World Bank and ADB, 2012, cited in FAO, 2019). A 24-hour time study in the FAO report shows that during the rice season, women worked roughly three hours/day more than men. The gaps in women and men's schedules is attributable to women's additional burden of domestic tasks. Even when women reported 'resting' they often admitted this included cleaning or weaving, while men's rest was usually smoking (FAO, 2019).

The mechanization of agricultural processes presents an opportunity to reduce women's workloads and balance work between men and women. Managing technology and machines is traditionally seen as men's work; therefore, introduction of machinery can shift some tasks that were previously women's responsibility to men. In one village where a rice mill was introduced by a project, the responsibility for rice milling was removed from women's tasks (FAO, 2013b, cited in FAO, 2019). The majority of women's labour contributions are undervalued and undercompensated (CAWA, 2017, cited in FAO, 2019). According to the United Nations' Country Analysis Report,

women complete 65 percent of uncompensated labourers carrying out family tasks, such as housework, and unpaid agricultural work (UN, 2015, cited in FAO, 2019).

Food security, nutrition, and land tenure security: Access to natural resources provides a level of food security, while selling the crops or natural products collected contributes to household income. A survey found that the most important measure to improve food security, ranked by women, was productivity of market gardens and paddy fields (or upland rice fields), to sell or consume the agricultural products (Stoeber, Sisomphone and Han, 2013, cited in FAO, 2019). NTFPs have also proven in several studies to be a highly important food source for rural communities but access is declining. Women are particularly impacted as they are the predominant collectors and sellers of NTFPs. Women may, therefore, be pushed to travel longer and farther to collect NTFPs, or suffer losses to their income. Loss of NTFPs also threatens food security and nutrition in already undernourished communities, as forest products like nuts, fruits and vegetables become scarcer in rural diets. NTFPs provide a source of income, increasingly important in a cash economy. The impacts of climate change in Lao PDR links with increased risk of disaster and threats to food security. Monocropping further increases vulnerability of crops. Failure can lead the diet-base or income source (FAO, 2019).

Under Lao law men and women have equal status with regard to land ownership and land-use rights, and women have legal capacity to enter into contracts or sign legal documents. In practice it is often the head of household (usually a man) who signs the tenure document. Land titling remains limited mainly to urban and peri-urban areas, leaving the majority of rural land untitled and unregistered. This makes it difficult to access loans or financing (to use land as collateral). Women from ethnic groups are most likely to refuse to have their name on a land title, believing land management is a man's role. Land thus passes on to sons only (FAO, 2013b, cited in FAO, 2019). Nutrition-sensitive agriculture (NSA) is becoming a priority for the government and development partners, and that NSA programmes should have gender-for-nutrition strategies addressing: Women's workload (avoiding diverting women's time away from nutrition-related tasks); Women's empowerment (which leads to better participation of women in nutrition activities); Women's leadership; and Cooking groups which can double as child care groups (FAO, 2019).

Access to markets and financing schemes: The most recent Lao Agricultural Census (2011) reported that 84% of agricultural households do not use credit. Women face further constraints in accessing financial resources and are overall less likely than men to take advantage of loans and credit. In households that reported male or joint decision-making, 15% had used credit or loans (MAF and FAO, 2014, cited in FAO, 2019). In contrast, 11% of female-decision-making households had taken advantage of these financial resources. Local-level banking mechanisms remain difficult for villagers to access, due to factors such as distance, or simply because they are non-existent.

Women are often deterred from accessing credit and loans. Issues include a lack of education and literacy, and a lack of confidence as bank processes are not always accessible to people who cannot read or do not speak Lao language. Banks can have particular criteria for taking out loans, require land titles, or groups of families to take out loans together, and mandate advanced financial planning. Due to the complex requirements many women regard the loan process as particularly burdensome and therefore do not engage in it due to a lack of confidence. The shift from subsistence to market-based agriculture may disadvantage women, who often struggle to access markets.

Decision-making and leadership: The LWU has a village-level body, which is the main avenue through which village women participate in the village committees. With the exception of the LWU, these committees are almost exclusively composed of men. The most common reason for women to be heads of households is widowhood (62 percent), followed by de-facto headship due to men leaving the household for labour or other reasons (20 percent) (MAF and FAO, 2011). One-quarter of National Assembly members are women and there is increasing involvement of women in government and local administration at all levels. However, this strong national presence does not trickle down to local levels (LWU submission to the Universal Periodic Review (UPR) process in 2015, cited in FAO, 2019) .

2.3 Division of labour (Key source: LWU gender profile 2018).

The LWU analysis[19] notes that women do most of the farm work (planting, weeding and harvesting crops), tend livestock, and also spend long hours performing off-farm and household chores such as collecting firewood, preparing

meals and caring for children. Traditionally, men plough, make bunds and prepare seedbeds. Women do more than half of the transplanting, weeding, and harvesting, threshing, and postproduction. In some areas, traditional task division is changing due to lack of men's labour (as many men migrate to seek jobs in the urban areas) (LWU, 2018)..

General trends in the Lao agricultural sector may affect women and men differently, especially in poor and ethnic minority communities. These trends include the implementation of land allocation and land titling policies, policies to stabilize shifting cultivation and reduce opium cultivation, and policies to promote new technologies and commercial agriculture. While the agriculture sector is undergoing rapid change through accelerated integration into market systems, most agricultural households are still engaged in subsistence or semi-subsistence agricultural production and most maintain a traditional gender division of labour (which varies between different ethnic groups). Women's roles in agriculture are often undervalued and their control over resources and participation in decision-making within rural households and communities is often limited. This transition is having significant social and economic impacts on rural households, including on women's roles and the gender division of labour. Increased agricultural productivity and opportunities for off-farm employment are helping pull some households out of poverty and providing new economic opportunities for women's ability to engage in market activities. However, others face serious constraints to accessing these opportunities: households and areas with limited assets and access to credit, or those who lose access to productive land and lack necessary skills to engage in alternative income generation face increased vulnerability. At the same time, social capital and other traditional coping mechanisms are under strain from social dislocation associated with the rapid transition. Shifting from subsistence-based to market-oriented household economies is particularly difficult for women in non-Lao-Tai ethnic groups whose cultural roles, limited Lao language and technical skills, and lack of business experience constrain them from entering into market production. Livestock production forms an important aspect of farming systems in Lao PDR and many households depend on livestock as an important source of cash income. Women and men jointly care for cows and buffaloes, while women take care of smaller livestock such as pigs and poultry. In those households that have goats, girls often have the responsibility for grazing and watching the goats (LWU, 2018).

Workload tasks (Key source Bishop-Sambrook, 2016).

The starting point for gender-sensitive development programmes for improved food and nutrition security is understanding the workloads and daily activities of all household members and how the time burden is distributed, in the context of livelihood strategies and gender relations (Bishop-Sambrook, 2016). Across all economies and cultures, women and girls carry out the bulk of unpaid domestic work. The work typically involves water and fuel collection; food processing, preparation and cooking; travelling and transporting; and caregiving. It is particularly laborious and time-consuming in many rural areas of developing countries, where there is no or limited access to essential public services and labour-saving technologies. Coupled with women's often unpaid role in subsistence farming, this means rural women spend a larger proportion of the day on unpaid and undervalued tasks than men. This can restrict the income they bring in and have control over, their mobility and voice, and the health and nutrition of the whole family. When children, mainly girls, help the women in their family perform domestic chores, their schooling suffers[20].

Ethnic women in remote communities often have limited choice about types of labour and the overall level of workload. Jobs requiring physical strength e.g. cutting timber can be a male preserve, although women's role in carrying firewood is equally arduous and requires significant physical strength. Some roles women can't do because it is ritually forbidden. Traditionally men labour roles have been concentrated around the productive asset of livestock, important as saving and coping mechanism during lean seasons, for responding to household shocks such as illness and death, as collateral for debt, and as income potential as draft animals. Hard work is valued within the family and is strongly associated with women's virtue. This is reinforced by the cultural norms that good women are strong, should do their duty and not complain or be seen to be weak. For most remote ethnic groups engagement with the cash economy is through sale of forest products. In all communities the poorer members hire out their labour at harvest and planting time. Where women have entered the cash economy, they largely take on work that is of lower value and payment that is often seen as an extension of women's work. Opportunities are limited and frequently require that women migrate to urban and peri-urban areas (Bishop-Sambrook, 2016).

Annex 3. Detailed review of specific LST options

3.1 Domestic workload LST

3.1.1 Fuel saving stoves

(Notes from Bishop Sambrook 2016).

Types of stoves:	
Mud stoves:	Fuel savings: 20-60 per cent from open fires. Fuel efficiency: 20-30 per cent.
Ceramic stoves:	ow-cost, durable, easy to maintain. Local source of income if manufactured and sold. Fuel savings: 30% from open fires. Fuel efficiency: 15-25 per cent.
Prefabricated stoves:	Heat up quickly, require little maintenance, attractive to users. Fuel savings: 30-60 per cent from open fires. Fuel efficiency: 20- 50 per cent.
Plancha stoves:	Specifically designed to provide a hot flat surface on which to cook food, such as tortillas in the case of Mexico and Central America. Fuel savings: 50-70 per cent (www.cleancookstoves.org).
Fireless cooker:	Uses stored heat to continue cooking food already partly cooked on a traditional stove. A simple basket, insulated with local resources such as banana leaves or old clothes, can reduce fuel use by 40 per cent (http://practicalaction.org/fireless-cooker).

Stove fuel:	
Firewood	Can be a renewable energy source if collected from sustainable sources such as woodlots. Wood-based fires can also be beneficial in terms of heating, repelling mosquitoes, binding thatch, and in cultural life. Smoke is also considered to preserve food, e.g. maize, dried meats.
Charcoal	Cooks food relatively quickly and produces less smoke than firewood. Home-based charcoal can be made from cooking with firewood, and taken to scale as an income-generating activity.
Biomass briquettes	(Organic waste densified into various-sized chunks) provide an environmentally friendly alternative to firewood and charcoal. Have a high heating value and emit 40% less carbon dioxide than firewood.

Stoves that promote the switch to cleaner and more energy-efficient modern biofuels	
Solar stoves:	Reflect solar energy to the cooking vessel. Useful as a complement to combustion- based stoves. Value highly dependent on local climate, cooking needs and availability of other biomass[2].
Alcohol stoves:	Burn ethanol or methanol very cleanly. Fuel efficiency: 70 per cent. Safer than petroleum by-products of LPG and kerosene because they do not explode. Stoves bring status, but are expensive.
Biogas stoves:	Use clean-burning methane gas produced by a domestic biodigester supplied with animal manure, human excrement, agricultural waste & water. Fuel efficiency: 50-65% (www.cleancookstoves.org).[21]

[2] Currently solar stove programming is are not evident. However, solar energy systems are available. For example: Sunlabob Renewable Energy is a Laos-based company specializing in renewable energy and clean water solutions. They focus on solutions that are sustainable – technically, economically, socially and environmentally. Products include Solar Energy - Grid Connected; Solar Energy - Off Grid; Solar Cooling; Solar Village Grid; Solar Water Pump Systems; Solar Water Purification System.

A risk noted (by the author) following fuel-saving stove distributions in remote rural settings was that the traditional open fire provides both warmth light and a social focal point. The smoke is used to preserve food hanging above (e.g. maize; dried meat) and is considered to repel insects.

SNV 'improved cookstove'

The SNV (INGO) 'improved cookstove' (ICS) is considered by the organisation to be more efficient and durable than standard wood/charcoal burning stoves in Laos markets, their website stating that households save 16,000 LAK per month due to fuel savings and durability, and 30 minutes of cooking time a day. Production of the ICS began in 2013 and had reached 100,000 units by 2016 through a public, private and civil sector partnership. The SNV program aims to gain revenues from carbon finance to continue its activities[22]. In 2017 the project introduced an Advanced Biomass Cookstove (ABC) in the Laotian market, to address health issues from smoke from cooking on wood and charcoal which they consider is significantly cleaner, safer, and more fuel-efficient than traditional alternatives[23].

SNV note that in the north, charcoal is rarely used for cooking (unlike southern Laos). For grilling they use a different stove[24].

Picture: SNV fuel saving stove

https://snv.org/update/first-ever-advanced-biomass-cookstoves-introduced-laos

Civitas – Fuel saving stoves

Civitas is a consulting company (with an office in Vientiane) promoting the use of fuel-saving stoves[25].

The focus is carbon emission reduction (environmental). Over the past 18-months Civitas piloted a 1000-stove distribution in Vientiane province. The model of stove promoted is a Chinese product which would retail at approximately $30 (Civitas distribute free). It is selected due to its comparative quality, longevity and efficiency, and is expected to last 5+ years (Civitas note that those already distributed are working after 18 months, meanwhile more basic clay improved stoves with lower grade casing tend to break within 6-9 months (the clay-ceramic grate and casing being vulnerable areas).

The pilot demonstrated (through cooking tests) that cooking times using the improved stove are less than traditional or improved stoves. It is efficient for steaming rice, frying, boiling, soups, and stir-fry and small barbeques (barbequing larger items (e.g. large fish) is more challenging).

The stove uses approximately 50% of the fuel of traditional cooking, which can be assumed to represent a 50% reduction in the need to source firewood for cooking. A change from traditional 3-stone or basic cook stoves is that it requires thinner/small wood and therefore an adjustment in terms of fuel collection.

Picture: Civitas fuel saving stove

Anecdotally, the project considered the reduced cooking time led to more time for women to relax/ have improved quality of life, noting that it is challenging to measure this directly as cooking is often part of multitasking domestic work. Other benefits include energy efficiency and forest protection [this may be an interesting area for further research]. Both men and women are invited to demonstrations (although no specific direct impacts on men are noted).

They are now scaling up to 100,000 stoves, working through partners (including INGOs) where possible (Civitas provide demonstrations, distribute stoves, conduct monitoring via 'village stove pioneers' (who are a focus for monthly data collection – updating Civitas by phone), partners provide transport from Vientiane to the village/province and basic data collection). The project will scale-up to Bolikhamxai, Khammoune, and Bokeo (in partnership with the LuxDev 030 project) and through other partnerships (further partnership suggestions are encouraged).

The project is funded through carbon credits, and so the team monitor the use (and therefore the relative carbon reduction) which links to financial motivation to see ongoing/sustained achievement.

It was discussed that ultimately, cooking with electricity would have more and better impact on carbon emissions. [The barriers to this transition in term of culture (communal/group food preparation/cooking/eating/socialising) as well as technology (affordable electric cooking as rural villages gain electrification) may be an interesting area for further research].

World Bank Fuel saving stoves (biomass fuel)

The World Bank have a plan to promote fuel saving stoves in Laos (a ToR for consultancy for this has been advertised). The design uses pellets of biomass (e.g. waste from the tobacco industry), and an electric fan to improve air flow. The focus is health/air quality, with an objective to reduce charcoal use in urban areas.

World Vision

Have been promoting domestic LST including stoves as part of nutrition programming. They have yet to publish results regarding impact.

3.1.2 Water filters

Various commercial HH filters are available in urban areas to be fitted to mains supplies. These can be expensive and require filter replacement. Also, many small towns have entrepreneurs that use reverse osmosis systems to filter water and deliver in reusable 20 litre plastic bottle (usually blue). For practical rural/upland household filters, a well-established option is the Terraclear filter. This is produced by artisans in Pakse (southern Laos). From their website http://www.terraclear.org/:

Extremely small pores in the ceramic are highly effective at the removal of bacteria, protozoa, helminths, turbidity and other suspended solids. The ceramic elements are infused with antibacterial silver to provide a permanent, secondary defence. The TerraClear Ceramic Water Purifier reduces bacteria by >99%. These filters, produced locally, are ideal for Laos as they need only gravity to function, require no ongoing consumables and are intuitive to use. Each filter produces and stores enough drinking water for a large family. TerraClear, founded in 2010, has produced and sold more than 60,000 filters. TerraClear operates as a social enterprise registered locally in Laos, seeking to achieve social and environmental objectives through sustainable business practices. The ceramic filter element has a potential useful life of 3 years or longer. Lifespan mainly depends on the quality of the input water and the care taken to avoid breakage.

The basic package (pictured is 450,000) Lak (as per website March 2020).

Picture: Terraclear filter

http://www.terraclear.org/technology/

Terraclear promote this as a health product rather than workload reduction. However, it reduces the fuelwood gathering and time needed to boil water. SNV included this as one of a menu of LST for households. They consider the filter was in the top three prioritised by target households and that it was considered to support labour reduction by women.

3.1.3 Rice mills

Motorised rice mills

The aim is to reduce women work and time burden husking rice by hand which can be a very strenuous and time-consuming daily task. The rice mill itself is an engine on a stand which links with a belt to run the milling machine. The machine cost is approximately 1,000 USD. Further costs include GI sheets, nails and wood to make strong secure housing for the mill. It is better if the stand for the mill is concrete. Often this is a shared asset due to the expense, but also the limited need for one household (many weeks of a household's rice can be husked in one short use). In this case a committee (for example a women's group committee) is needed to manage user fees to cover fuel (0.5 litre/ hour can husk 200kg white rice) and maintenance costs (changing the belt once a year; change oil once a year, repair housing) (CARE,2014). The strength of the management will determine the success of the activity.

Picture: Thai mortised rice mill

The introduction of the machine can transfer the task to be a more male role. However, as it substitutes an early morning domestic task it does not necessarily translate into a role reassignment for women (it reduces the need to rise at 4.00am to pound rice).

Water-powered rice mills

As with motorised mills, the aim is to reduce women work and time burden husking rice. The main requirement (and limitation) is a need for a stream water source that is perennial but not subject to significant flooding that would damage the structure (and rice). Costs are limited to a GI roof sheets (to protect rice from rain); 3kgs of nails; 3 boxes of roofing nails, and 100mm PVC pipe (1x 4m piece is normally sufficient). Labour needs are estimated to be 1-week x 2 people to make the pestle and mortar, and 1 day for 3 people to prepare the shelter/housing. The wood for the pestle, mortar and roof frame is a household contribution. Training is required for construction (CARE,2014).

Picture: Water powered rice mill

Risks include non-operation in the dry season if the stream flow reduces significantly, and loss of rice to animals (and people) as it is left unattended all day to mill (It is unlikely that the mill can be built within view of each house).

3.1.4 Biogas

SNV implemented a Biogas project between 2007 and 2011. Their website notes that 2,405 household biodigesters were constructed in five provinces in Lao PDR, and suggest that the use of biodigesters has meant that the women and children who normally collect wood in the forest have saved some 1.5 million hours of labour time[27]. Other HH projects are not evident in online searches. The sae Lao project encourages use of biogas digesters, and has one at their site from the SNV project[28].

From discussions with SNV it is hypothesised that low rural use of latrines/on site sanitation and prevalence of free roaming rather than stalled livestock are challenges to biogas implementation. Where there is genuine behaviour change towards latrine use and livestock stalling is practiced/established then biogas digesters may be increasingly viable. It is also noted that waste from coffee hulling would be a suitable material for use in a biogas digester.

Picture: Biogas digester under construction

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Theuambounmy, H. (2017)[29] notes that large scale biogas technology for wastewater was introduced to Laos in 2009. Currently, there are two examples of applying biogas technology in Laos. One is applying biogas technology to treat wastewater from a starch factory at the Indo-China Starch Factory in Vientiane capital. Wastewater (5,600 m^3) feeds to a biogas digester every day and produced biogas (28,000 m^3 per day). The produced gas is burned as substitute fuel to dry starch. The second applies biogas technology to treat wastewater from a pig farm in Phonhong district, Vientiane province (4,000 heads of pigs). The biogas digester (2,500 m^3) produced gases is used as fuel to generate electricity (260 KW) for farm facilities.

A recent study by Vongvisith and Wudi (2018)[30] notes that the majority of livestock in Laos are buffaloes, cattle, pigs, and poultry. Large amounts of livestock manure are produced from each region and can be feedstock as substrate for biogas digester, estimated to be 1,583,740 kg TS/day, and equivalent to 439,917 m3/day of biogas production or 658,376 kWh/day of energy generation.

3.1.5 Water supply

Gravity-fed systems enable clean water availability near to houses, which can save time spent and burden for water collection. However, this intervention is dependent on the location of an appropriate water source, and so it is not always possible to provide to all target village locations. Other options include drilled wells.

Women often have the primary responsibility for water collection. When children help, it can be before, after or during school, taking its toll on their time and energy for education. When it takes a long time to collect water, women cannot carry out other activities. The mode of transport of water also has a bearing on women's time and health. Unsafe and insufficient water for domestic purposes causes water-related illnesses. In turn, this increases women's workload because they are then responsible for caring for the sick and taking them for medical treatment. Medical costs also increase. and can affect the individual's need for and ability to benefit from food, and results in chronic undernutrition Bishop-Sambrook. C (2016).

The task of collecting water can be eased by creating sustainable sources that bring safe and reliable water closer to households: Protected dug/shallow wells and pump; Tube wells or boreholes and pump; Piped water into house, plot or yard; Protected springs; Public tap or standpipe; Rainwater collection, namely roof rainwater harvesting.

Accompanying approaches to help ease women's domestic workload include: Multiple Use Water Services (MUS), an approach to provide integrated water services for multiple uses. The reality of daily rural life demands water for domestic purposes, plus for small livestock watering, kitchen gardening and income-generating activities. Since

women undertake these activities, improved access to safe and sufficient water is highly relevant to ease domestic and productive workloads.

The hardware (physical infrastructure) of water investments must be matched with the software (human and organizational capacity) if the outcomes are to be sustained. Water supply facilities in rural areas are predominantly managed by community-level water management committees. The formation, training and other support given to the members of these committees will determine the sustainability of the infrastructure.

Highly variable rainfall (in terms of location, frequency and intensity) and higher temperatures mean that many communities will face more and longer droughts and a higher frequency of floods. Given the current substandard rural water infrastructure and management systems, this variability can lead to an increase in both water collection times and the risk of water-related diseases.

3.1.6 Other domestic appliances

SNV in Laos identified that unproductive work is a bottleneck for time efficiency and decided to promote domestic LST. They had a list of 10 options for qualifying households in Oudomxai to request to a value of 800,000LAK to support kitchen/cooking efficiency and household food processing. This would also then link to nutrition aims. The list included the ICS stove; handcarts; electric cooking pots; water filters; blenders; rice cooker; water boiler; meat grinder (for laap). The stoves, water filters and handcarts were the 3 most popular choices. Anecdotally, saved time appears to be used for child minding and home gardening. An FGD based review of this is ongoing at the time of writing. There were concerns that the appliances would increase electric bills, but people found the increase was relatively small, e.g. 5,000LAK[31].

Annex 3.2 Agricultural workload LST (Women-Friendly)

3.2.1 Rice cutter

(modified brush cutter/strimmer)

Three papers were identified that reviewed the efficiency of the rice cutters. Perhaps more relevant is the Thai study which considers the cutter to be 7.8 times faster in terms of person-work hours than manual cutting (the Indonesia study has a similar reaping rate, the trial in India was slow but the manual harvest rate is much faster, suggesting these numbers can be used as a guide only).

Rice cutter review of efficiency

Study	**Units**	**Genesh et al**	**Sarkar et al**	**Handaka & Pitoyo**
Location	*Study*	*Thailand*	*India*	*Indonesia*
Rice cutter	hrs/ Ha	15.6	34.5	19.0
Manual	hrs/ Ha	121.3	76.9	?
Efficiency	Manual/ cutter	7.80	2.23	NA

Interestingly, the study from Thailand (Ganesh Boro and Gunner, 2007)[32] notes the method has potential where land holdings are very small and capital resources are low. As shown in the table, they calculated that the rice cutter could cover 643 m2/hour, using 0.25 L of gasoline. It would therefore take just under 16 hours for 1 hectare, and so was considered to be 7.8 times faster than manual harvesting. They estimate the cost to be 4.9 times less than manual harvesting with the break-even area being one ha and the payback period one year. The Indonesian example[33] shows a similar harvest time (19hrs/ha) and a perhaps more realistic fuel consumption of 1 litre/hour. The example from India[34] required more than double the time for 1 hectare and compared this with a much lower manual time. Despite this the time needed was still 2.23 time faster.

Ganesh *et al* (2007) in their review of the rice cutter make the valid observation that women play an important role in rice harvesting, but when an alternative source of farm power becomes available, it is usually the man in the family who uses it, which often leaves the women as disadvantaged and overworked as before [i.e. men take the mechanised job and women are reassigned to different labour]. They note that a small and light machine suitable for averaged

sized woman to operate, would boost their participation in farming activities and that women would also be able to operate this machine, as it is light and handy and thereby women would also enjoy the fruit of mechanization.

Picture: Rice cutter

Sarkar Bikash, et al., (2016)

It might be assumed that threshing by hand (and not machine) will be practiced where rice is also harvested/ cut by hand. The focus of women's role as labourers may therefore shift to threshing if men begin using a machine to cut the rice. The author observed in Dak Cheung that the rice seed was stripped from each stem by hand before the stalks are cut. Again, in this case it could be assumed that women would be assigned this and similar labour tasks with cutting the stems becoming a male role.

3.2.2 Drum seeder

This technology has been trialled by FAO (through DAFO) in Sayabouli (following past successes in India)[35]. The FAO study noted that one hectare of land can be planted in one working day by one person with the drum seeder (compared to 29 person-days for manual transplanting), saving more than 90% of smallholder farmers' time, as well as 60% of seed compared to transplanted rice. Compared with broadcasting seed the difference in time saved is small (1%) as 1 Ha can also be done in one day [arguably, as the seed is not buried this technique is perhaps more similar to broadcasting seed]. The LST is environmentally-friendly as it is pulled (so does not require fossil fuel) and increases climate change resilience as farmers can quickly replant if 'just planted' rice is lost (e.g. due to erratic rainfall after planting). The 12-row drum seeder weighs approx. 15 kg and costs between USD 60 to 100 depending on the quality. The FAO study estimates the net income for small holder farmers when using a drum seeder is 601 USD per ha, and 454 USD for transplanting (with reduced labour costs but the same yield). For broadcasting it is 595 USD per ha as there is no labour time reduction). The drum seeder also provides an opportunity for additional income by providing seeding services to neighbouring farmers and freeing up labour time. However, the study notes that (as with many labour-reducing technologies) it may reduce casual labour options for women and increase their vulnerability. Further risks for the drum seeder include seeds exposed to birds and seeds can also be washed away during heavy rains. Farmers in Sayabouly reported more weeds compared to manual transplanting (other countries introduction of the drum seeder was combined with improved weed

Picture: Drum seeder

The 12-row drum seeder used by farmers in Sayabouly province

management) and that only the plots with a reliable supply of water are drum seeded. Most of the operators of the drum seeder in Sayabouly are men; in only one household out of eleven using the drum seeder is there a woman using this technology (the study notes that the Farmer Field Schools that trained on the drum seeder were mostly attended by men (78 percent).

It should be noted that this LST was used in Sayabouli where there is significant paddy rice production (rainfed and irrigated) and FAO and others identify labour shortage issues.

3.2.3 Handcarts

In rural areas of developing countries, women and girls spend more time and effort than men travelling on foot while carrying heavy loads (IFRTD, 2015, cited in Bishop Sambrook (2016)). In environmentally degraded areas, women may also be forced to travel longer distances in search of firewood and water. With less access to and control over resources, women have fewer opportunities than men to use different types of motorized and non-motorized travel and transport technologies to ease the burden of transport. Two approaches can alleviate the burden of transport for women: intermediate means of transport (IMTs) and improved paths and feeder roads.

Picture: Handcart

IMTs (e.g. wheelbarrows and carts) can be used for collecting water and firewood as well as carrying tools to and from the fields, carrying crops from fields to grinding mills and markets, and transporting children and the elderly to health clinics. However, their value strongly depends on their acceptance by women and men and how they are subsequently used. For example, IMTs such as bicycles can change who performs a domestic task from women to men. However, men may also see the value in bicycles for their own needs, leaving the women to conduct their domestic tasks as before. Improved paths and feeder roads make IMTs easier to use. They also physically enable the extension of public transport systems, which can make longer travel easier for women, provided they are affordable and safe. Accessible roads also enable children to go to school (Bishop Sambrook (2016).

Picture: Handcart - more durable wheel

Firewood collection and cooking

People (especially where there is no or unreliable electricity) still rely on firewood, charcoal, crop residues and manure to cook and heat their homes. The overwhelming majority of people who rely on traditional biomass live in rural areas (IEA, 2014, cited in Bishop Sambrook, 2016). Obtaining fuel from wood requires travel time to find it, and then time to cut and transport it, and prepare it for burning and use. The largest share of the burden is carried by women. Cooking in most rural households is still undertaken by women and children on an open fire (three-stone cooking) or an inefficient stove, requiring a lot of traditional biomass as well as time. Poorly ventilated smoke from cooking with such fuels exposes households to high levels of air pollution. Over time this can lead to cardiovascular, respiratory and eye diseases, as well as cancers.

Most poor rural households are on the bottom rung of the "energy ladder", using the least convenient and energy-efficient biofuels: wood, crop residues and manure. Charcoal, coal and kerosene represent higher steps, and electricity and LPG (liquefied petroleum gas: commercial butane and propane) are at the top. Fuel-efficient stoves reduce the time needed for firewood collection and cooking and promote more efficient and sustainable use of traditional biomass (Bishop Sambrook, 2016).

The provision of handcarts makes some tasks, such as carrying wood, NTFPs or harvested crops, easier, particularly where women normally carry wood and other items in baskets on their backs. The handcart load can be 100 to 150kg on flat terrain, less where slopes are steep. The degree of utility is often dependent of the extent to which the handcart can usefully travel between the resources and home, a difficult track or steep hill being a barrier, in which

case wood for example can be carried to the point that the cart can access, and the handcart is used for the remainder of the journey. In some cases, the technology encourages men and other family members to be more active in carrying wood/resources from the field/forest. Meanwhile, some women report that husbands no longer help with wood collection, as women have the wheelbarrow so don't need their support. It has been observed in Sekong that upland households had considerable stocks of firewood under their homes within 1-2 years of using the handcarts.

In villages in Dak Chueng, 1 trip for firewood collection with the handcart could bring enough wood to last for 2 weeks (compared to 5 trips per 2 weeks if carried on the back). This activity is more appropriate where there is flatter land. In very mountainous areas the handcart is used more for transporting in and around the village[36].

Equipment for construction includes: Handsaw; Hammer; Chisel; tape measure; Square; Hand drill; nails (3kg); hand plane; adjustable spanner, ball bearings; wheel rings; file; wheel; handpump; tyres/inner tubes; tyre repair kit. It has been noted that motorbike wheels/spokes can be damaged easily, and it is possible to buy wheels that have re-bar for spokes which are more durable and preferred by users. The tools can be shared by groups to make handcarts together. The household contribution is wood (5cm X 10cm X 220cm 2pc; 4cm X 8cm X 220cm 4pc; 2cm X 20cm X 220 4pc) and labour (3 people x 3 days).[37] Construction and maintenance training is needed. Maintenance can include changing the inner tube annually and the tyres after 18 months. It is better to have 1 handcart per household (not shared across households) so that maintenance is carried out and responsibility for maintenance is clear.

Maintenance costs need to be planned as part the participatory approach prior to implementation. It was found in some villages that household delayed repairing broken handcarts until they were more needed (in the dry season/harvest). Where handcarts were shared between households it was unlikely that they would be repaired (each household expecting the other would eventually do the repair task and manage the cost). Ownership and responsibility improved when distribution was made by household.

3.2.4 Small scale irrigation

Small scale irrigation construction and water pipes designed to take water to the farmland are likely to enable the villagers to access more productive land, and with increased productivity and reduce the need for swidden cultivation. This will reduce the burden of more strenuous work in the upland swidden fields, reduce distance travelled to fields. Submergence of the ground through (irrigation/water control) helps in suppressing weed growth, and therefore the reduction of time needed for weeding. Flooding usually improves soil chemical conditions and the anaerobic soil environment prevents the germination and growth of many weeds, noting that herbicides may provide the main means of control, these alone are unlikely to be successful unless combined with good land preparation and, in the lowland systems, good water control[38].

Picture: Example irrigation structures

3.2.5 Improved fencing (barbed wire)

Barbwire with sufficient strands to prevent livestock entering crops can reduce the need for labour intensive construction and maintenance of wooden cattle-proof fencing in steep upland slopes and reduces time each year for fencing tasks in upland fields. Women's groups requested barbed wire to reduce annual fence repair/ construction in upland communities in Sekong. Fencing sufficient to control buffalo on upland slopes is often made with large pieces of lumber which need to be lined up next to each other, requiring huge effort and labour as well as a lot of wood resource. Reducing this task can have a significant impact on time saved. Some documents online identify fencing as a male task, so this requires assessment before LST is promoted.

3.2.6 ICT

ICT use can decrease women's time burden directly: - It allows direct communication with clients, middlemen, markets and suppliers, decreasing time needed for travel. Mobile phones can be used to coordinate supply/marketing and reduce transportation costs, saving time and increasing income. Entrepreneurs can run businesses from home, and also oversee domestic work. Mobile-phone based financial transactions provide access to financial services for those without a bank account, and save time by reducing travel to financial institutions. Mobile-based transactions can also reduce safety risks linked to women travelling with cash when returning from long distance markets. –

UNCDF in Laos implements 'Making Access to Finance More Inclusive for Poor People' (MAFIPP)[39] programme and introduced the Mobile Money for the Poor (MM4P) programme. UNCDF is implementing Shaping Inclusive Finance Transformations (SHIFT) programme to accelerate financial inclusion and women's economic participation in the ASEAN region. UNCDF have worked with BCEL who have identified agents to support remote financial services. The ICT enables remote rural people to make money transfers without having a bank account if there is BCOME agent. The receiver also does not need a bank account. The sender provides identification using an ID card (ID Card, Family Book Certificate, Military ID Card, Police ID Card, Retirement Staff ID Card, passport and Monk ID Card). The person who makes a transfer with the agent will receive a 7-digit number. They then need to inform the beneficiary of those digits in order to verify themselves as the receiver at another agent[40]. The agents also provide other financial services including paying utility bills, road tax and banking. However, for rural people with poor access to banks and no account the transfer service is significant. In terms of workload reduction, it saves considerable travel times going to district banks as well as risks in terms of holding cash. It also has potential to increase the financial decision making and control by women.

ICT is a particularly flexible and time-saving resource as it can allow women to access agricultural and productive information from home (Huyer, 2012, cited in Grassi, 2015). Mobile phones can give access to weather forecasts and help farmers to make decisions on when to sow (Lybbert and Sumner, 2010, cited in Grassi, 2015). As farmers deal with changes in climate and more variability in weather, local memory becomes a less reliable guide. ICT can be used for early warning systems (accessible to rural women) for transmitting information on livestock disease outbreaks or locusts. This is not an area which is well established in Lao (from initial review) but has potential as the use of phones is increasing. https://laofarmers.net/ is a website that has some information for Lao farmers, but does not seem to be in a 'news' regular update format. There is potential to see how ICT is used regionally in Cambodia and Thailand to see what can be transferred. It may be that encouraging farmers to check existing weather apps, or to share livestock disease information via social media groups can have impact without the need to develop new apps.

It is noted in the Vientiane Times[41] that MAF is engaging in the development of apps to support the sector: The Department of Livestock and Fisheries under the MAF has signed with Germany's TE-FOOD International to develop a mobile application which will make the management of livestock farms more efficient and cost effective. The two partners will work together to create an app that will streamline the management of livestock diseases in Laos. It is expected to make reporting of disease outbreaks much easier for farmers who will be able to alert authorities with all the required information via their mobile phones. Statistics and data gathered through the app will help ensure quick, clear and strategic responses to protect farms and livestock.

Vial (2019) notes that modern communication technologies, like YouTube, Facebook and other social media, give the extension systems the opportunity to engage a wider, receptive audience. This has already been done for some endeavours at NAFRI. [These endeavours were not detailed in Vial's paper on DSR but may deserve further investigation if LURAS decides to engage in this element of WWL reduction).

3.3 Other options (less women friendly/ stand-alone)

3.3.1 Knapsack sprayer

Rodenburg, J. (2013) reviewing hand-weeding options notes that weeding one Ha of rice is a 10km walk, head down, hand weeding is 30 to70% of total labour demand; and that 88 to 97% of time hand weeding can be saved by use of herbicides[42]. Knapsack sprayers are a technology that women can use (lighter options are available as needed).

However, as noted by Chivinge et al (2003)[43] there is a need for good technical knowledge (use of right nozzle; correct pesticides; equipment; correct/safe products; use of safety equipment; storage of herbicides/pesticides; avoiding exposure to chemicals [etc.) which suggests that this LST for WWL reduction should be part of a technical crop management program rather than as a stand-alone intervention.

3.3.2 IAA (Integrated Agriculture Aquaculture)

FAO[44] note that IAA has been adopted in a traditional form for a very long time (but yielding unpredictable production results). Where use of pesticides in rice fields is being discouraged or is very limited, the scope of rice plus fish culture greatly increases. The FAO suggest minor alterations in existing rice fields like raising embankments, constructing fish catching pits, and protecting water inlets and outlets to avoid escape of stocked fishes and to protect against entry of predators and wild fishes. There are three possible combinations of IAA:

- Perennial (year round) water source. (The duration of fish culture is usually 90 or 180 days).
    - One or two crops of rice and fish grown together; generally, one crop of rice is more common.
    - One crop rice + fish and an alternate crop of fish alone without rice
- Seasonal water source. (duration of culture is usually 90 days). One crop of rice with fish only possible in this case. (Typically, the growth period of rice is 120-130 days from July to December (wet season rain-fed))

The fish production levels will depend on proper management, i.e., timely manuring, eradication of predators and wild fishes, correct stocking density (checking over-population), species selection (e.g. carp) and ratio of stocking, combined with manuring and feeding wherever possible.

May (2018)[45] notes that the coculture of flooded rice and fish provides subsistence food and protein sources on limited land areas. Poultry farming can also be incorporated. A typical example is the rice-fish-duck complex system. Fish and ducks are the predators of pests, weeds and their eggs/ seeds. The waste of fish and ducks forms natural fertilizer for the rice. When comparing the fields of the same rice yield, it is found that the coculture system consumes 68% less pesticides and 24% less synthetic fertilizer (Zheng et al., 2017 cited in May, 2018). This suggests work reduction in weeding. However, May focuses on perennial fish farming which requires deep trenches for fish refuge areas when rice paddies are drained for harvest (at least 50cm deep) and proper bamboo gates and screens at drainage points to avoid escape of stock fish (Cruz et al., 2001, cited in May 2018).This also requires good water management: The water depth in the system is strictly controlled as rice requires different water levels throughout its lifecycle. After the rice is harvested, the fields need to be reflooded in time to provide habitat for the carps. All of which implies considerable additional work.

Nouhak et all (1998)[46] made a gender analysis of aquaculture. They found that men and women usually share tasks and responsibilities in rural aquaculture production. Men's aqua-culture tasks/priorities included: pond site selection and construction, digging, pond clearance and repair. If villagers have to travel far to a district or provincial area to buy fingerlings, it is a man's responsibility. Whether the husband or wife controls the money is an important consideration. For fingerling purchase, often the amount of cash required is small enough to be under the financial control of the woman. Women are responsible for pond fertilization, maintenance and feeding. Men generally operate pump or pond gate operations and other water exchange practices. In general, women prepare feed for fish, such as collecting rice bran, grass and any other available vegetable wastes. Although women may be responsible for feeding fish, there may not be an increased demand on women's labour for rice-cum-fish cultivation in comparison to rice-only cultivation, as people generally do not tend to feed the fish in the rice paddies. Most women make decisions

about harvesting fish for daily/weekly family consumption, any overall major harvest of fish is under the control of men. For rice paddies, although draining water from the rice paddy is a man's responsibility, both women and men collect and harvest fish from rice paddy fields. Fish marketing- women are the sellers, and are responsible for the price of fish. In all Lao Loum households women were exclusively involved in the making of a fermented fish sauce "padek" for household consumption. Rural women vary considerably with respect to their interests, priorities and time available. Women with older children may be the most suitable group for initial aquaculture related activities, because they are less busy with children, and they tend to feel more confident about attending training. Indeed, the study found that older women tended to be more interested in raising fish than women with young babies.

3.3.3 Single axel tractors/ toktoks

Whilst it would be unlikely that use of a toktok would directly translate as LST for women, it can be seen in the picture that the toktok is being used for wood collection, a women's role carried out by a man. (it is notable that the amount moved in 1 load is high, and the pieces are large. However, it can also be expected that the movement of wood to the roadside that is accessible to the toktok will continue to involve women.

Picture: Hand-tractor – labour saving

Toktoks also provide general transport of food, crops and people to and from the market. To some/ a lesser extent, this can also be achieved using a moped which is a transport technology that is more accessible and used by women. The *Laowomen* review notes that women generally cannot ride motorbikes. The author did not observe this as the case in southern uplands, suggesting this is less a physical barrier and more a cultural one that deserves further review.

3.3.4 DDR (Direct Drilled Rice) [or Direct-seeded rice (DSR)]

DDR are seeding machines that fit to the rear of a single axel tractor/tok-tok, most suited to paddy farming. They replace manual transplanting, addressing labour shortage issues. The activated seeds are planted before the fields are flooded. This reduces the climate-related risk of unpredictable rainfall which impacts if seedling nurseries are ready for transplanting before there is sufficient rain. A study by Xangsayasane et al (2018)[48] compared methods in 10 farms in Laos. Drilled crops produced slightly higher yield compared with manual planting. They concluded that the seed drill is relatively cheap and easy to operate and saves the time and cost of hiring labour. Where manual transplanting is still practised but labour shortage has started to increase the labour cost, the drill is likely to be well adopted. In the area where broadcasting is already practised, the drill may still be adopted due to improved crop establishment and ease of weed control (the major problem associated with broadcasting is weeds, and with limited

Picture: DDR

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use of herbicides, farmers often revert back to manual transplanting (Fukai & Ouk, 2012 cited in , Xangsayasane et al (2018)).

A recent study by Vial (2019)[49] regarding DSR made observations about DSR use and time saving. Direct-seeded rice increases labour productivity resulting in more rice from existing labour, or freeing time from rice farming for other activities (Clarke et al.,2018, cited within Vial, 2019). DSR can save 30 percent of labour, but that saving can be lessened or even lost by greater labour required for weeding (Vial and Newby, 2014, cited in Vial, 2019). A rapid uptake in DSR has been observed in Savannakhet since 2014. However, since 2017, the area of DSR has stagnated or fallen in most rice-producing districts; some farmers have even returned to transplanting. It is noted that if weed infestation increases (can do so over time where standing water is less reliable) the result can be a very low yield and/or consumes more labour in hand-weeding than that saved from avoiding transplanting.

Meanwhile, it is noted that labour saved, (especially for women and girls), is generally used to diversify their livelihoods away from rice. A range of other on-farm, off-farm (including transplanting for others) and non-farm options were reported including growing other crops. For example, farmers reported growing vegetables, mushrooms, or sugar cane for the factory. Some women reported spending more time on weaving for commercial purposes or starting a retail business. (Quotes highlighted were: 'DDS technique is very easy and requires only two men. So, women have time to do other work.'; The women have time to join social work happening in the village'). It was also suggested that this shift from labour time used for rice farming could accelerate out-migration from rural areas, to better non-farm options and provide more opportunities for young people to continue their education with minimum interruption during the rice growing season.

3.3.5 Food processing

Food processing for domestic use:

Seasonal foods can be processed (e.g. jam) when fruits and other foods are more easily available, and stored for use in the off season.

The ADRA food security project in Xieng Khouang (current project cycle started 2019) will engage with food processing and food storage activities, with a focus on food security and an intention to reduce women's workloads (currently at an early stage of implementation). They will also implement small irrigation systems which will save time related to women carrying water for their home gardens, greenhouses and livestock (Annex 3.2.4), as well as water access for people with disability (Annex 3.1.5, - impacting on time for water collection but also time in care work – this being one of the four areas of domestic labour highlighted in figure 8).

VFI's work at the Green Earth Centre (Salavan) primarily focuses on sustainable agricultural as well as vocational training to trafficking survivors, and their families[50], and therefore has significant experience in women-focused livelihood activities. An example of livelihood opportunities that reduce workload, suggested by VFI[51], given was household mushroom cultivation. This reduces time to collect wild mushrooms (NTFP) whilst also providing income (IGA). They can process the mushrooms, drying and packaging, and so can then sell later or store for a time when there is less food. They also ferment the mushrooms rolled in banana leaves to make 'Neam'. Another example at VFI is growing passion fruit which can then be processed and made into juice or jam (for storage or sale). They also use Mak Mao (wild black current berry) to make juice (or wine). It was explained that the time needed for processing is little compared to the time/effort to find NTFPs. For example, a large volume of passion fruit can be picked, cleaned, peeled and have the juice extracted and put in bottles over a period of two half-days. Income generated from this might be equivalent to months of collecting NTFPs [noting that the time for growing the passionfruit (making the frame, planting, tending) also needs to be considered]. [The focus on income is also linked to women's equality – see section 2 of the report]. VFI also help people to process local products including banana (fried), pineapple, pumpkins, and vegetables (fermenting) to help preserve food.

Xaoban is a local company (shop in Vientiane) selling processed products (yogurt; jam, honey) supporting remote villagers to sell products. However, the focus is more IGA than workload reduction (IGA in itself can increase agency and therefore this may impact time efficiency and life quality but IGA is not directly an LST).

3.3.6 Rice/Crop processing

It is estimated that women provide 85 to 90 per cent of the time that is spent on household food processing and preparation across a wide range of countries (FAO, 2011[52]).

Household food processing and preparation includes shelling, threshing, cleaning, drying, storage, milling, grating and oil extraction. Traditional manual means of crop processing are generally time-consuming and arduous. However, improved technologies, such as grinding mills, cassava graters and oil expellers, are now found in much of the developing world, reducing processing times from hours to minutes and providing an income-generating activity (Carr and Hartl, 2010, cited in FAO 2011).

Mechanized crop-processing technologies are predominantly owned by male entrepreneurs, because of the investment required, followed by community organizations and women's groups. Mechanization has also often moved processing from a household level to group, community and industrial levels.

Although processing services have freed up time for some women, they can be too costly for poorer households. Manual and/or cheaper technologies are more affordable, given the resources of women and vulnerable households, but this must be matched with effective performance. Improved processing technologies and storage methods also provide opportunities to reduce food waste. Preserving more of the harvest translates indirectly to saving labour.

Development programmes may combine the provision of food-processing technologies with an energy supply, e.g. a diesel engine and associated tools such as grinding mills, huskers, battery chargers, pumps, welding stations and carpentry equipment. While widely reported to reduce the daily drudgery of women's work, there were also widespread problems in the local capacity for preventative maintenance and repair and in access to spare parts.

Integrated Food-energy Systems (IFES), combine food and energy production on the same site. Agroforestry includes growing trees for fuelwood and charcoal as well as producing food, and the use of by- products for example, biogas from livestock residues.

Harvesting and post-harvest processing and storage are activities where women need increased knowledge of techniques and access to specific technologies to improve product quality and quantity (Bishop-Sambrook, 2016).

Annex 4. Case study of daily tasks

FAO (2019) case study of daily tasks (division of labour) in Phaxai district, Xieng Khouang.

Division of labour during **rice season** in Ban Nasom		
Time	***Women***	***Men***
4-5 a.m.	Wake up; make fire; cook rice & breakfast; feed ducks/ chickens	Wake up; smoke; go to rice field at 4:30
5-6 a.m.	Cook breakfast; feed animals, or go to market (some days)	Work in the rice field
6-7 a.m.	Bring breakfast to rice field to eat with husband	Work in the rice field
7-8 a.m.	Eat breakfast	Eat breakfast
8-9 a.m.	Work in the rice	Work in the rice
9-10 a.m.	Work in the rice	Work in the rice
10-11a.m.	Work in the rice	Work in the rice
11 a.m.– 12 p.m.	Return to home to cook lunch at 11:30	Return home at 11:30
12-1p.m.	Eat lunch and clean up	Eat lunch and rest
1-2p.m.	Work in the rice field	Work in the rice field
2-3 p.m.	Work in the rice field	Work in the rice field
3-4 p.m.	Herd cattle	Herd cattle
4-5 p.m.	Work in the rice field	Herd cattle
5-6 p.m.	Work in the rice field	Herd cattle
6-7 p.m.	Feed chickens and ducks	Return cattle
7-8 p.m.	Cook dinner	Rest; wait for wife to bring dinner
8-9 p.m.	Eat dinner	Eat dinner
9-10 p.m.	Clean up from dinner Rest; go to bed at 10 p.m.	rest; go to bed at 10 p.m.

Division of labour: **off-rice season** in Ban Nasom	
Women	***Men***
Sleep	Sleep
Wake up; make fire; cook rice & breakfast; feed ducks/ chickens	Sleep
Cook rice & breakfast; feed ducks/ chickens, or go to market (some days)	Wake up; release cattle; go fishing
Eat breakfast	Eat breakfast
Work in the vegetable garden	Work in the vegetable garden
Work in the vegetable garden	Work in the vegetable garden
Feed baby chickens	Work in the vegetable garden
Feed baby chickens	Eat lunch
Eat lunch	Rest
Rest, weave, or work in the vegetable field	Cut bamboo for bamboo strips
Rest, weave, or work in the vegetable field	Move cattle
Work in the vegetable field. pick vegetables for dinner	Herd cattle
Work in the vegetable field. pick vegetables for dinner	Herd cattle
Feed chickens and ducks	Herd cattle
Feed chickens/ducks; cook dinner	Herd cattle
Cook dinner	Make bamboo strips; wait for wife to bring dinner
Eat dinner	Eat dinner
Clean up from dinner; feed dogs; make pig feed; go to bed 10 p.m.	Go to bed at 9 p.m.

Hours		Rice season			Non rice season	
Categories	***Sub tasks***	***Women***	***Men***		***Women***	***Men***
Domestic work	Cook/make fire	2			2.5	
	Feed animals[3]	2			4.5	
	Clean	1			1	
Farm work	Work in veg garden				4	3
	Travel to fields	1.5	1			
	Work in rice field	7.5	7.5			
	Herd cattle	1	4			6
IGA	Cut bamboo strips					2
	Weave				1	
Sub total		**15**	**12.5**		**13**	**11**
Eat		2.5	2.5		3	3
Rest		0.5	3		1	1
Sleep		6	6		7	9
Sub total		9	11.5		11	13
Total		**24**	**24**		**24**	**24**

Time allocation following laowomen.org categories

24-hour time study in the FAO report shows that women had a more diverse workload than men and consistently had more working hours during the day than their husbands. The additional number of hours women worked compared to men differed by village and season: during the rice season, women worked roughly three hours more than men. The gaps in women and men's schedules is attributable to women's additional burden of domestic tasks: when men were sleeping, resting, or showering, women frequently were cooking or cleaning. Even when women reported 'resting' they often admitted this included cleaning or weaving, while men's rest was usually smoking.

[3]Can be debated whether this is farm or domestic work. It is mostly considering livestock near the house rather than cattle.

Annex 5. LST – barriers and enablers

Barriers in women's access / adoption of labour-saving technologies (based on Grassi (2015) and Bishop-Sambrook (2016)):	
Education: Grassi (2015)	Rural women's low education and literacy levels affect their capacity to make informed choices. Women's illiteracy or lower educational levels inhibit their understanding and use of information and services.
Access to complementary inputs (Ragasa, 2012, in Grassi 2015)).	The differentiated access to complementary inputs (such as education) explains the difference in adoption decisions (Ragasa, (2012) cited in Grassi (2015)). Recent literature notes the importance of empowering women through participatory technology development that seeks to **incorporate their perspective so that they are able to help themselves** (Carr and Hartl, 2010, cited in Grassi (2015)). Technology adoption is often constrained or cut short by lack of access to inputs and services such as credit, fertilizer and information. Even if women have equal access to extension services, a lack of complementary knowledge or necessary inputs will restrict their ability to take full advantage of introduced technologies or techniques (Doss and Morris, (2001) cited in Grassi (2015)). The services available to women and their ability to use them are affected by social norms, cultural practices, lack of education, and lack of recognition of their triple role. Women tend to make less use than men of extension services (Meinzen-Dick et al., (2010) cited in Grassi (2015)).
Men and technology: Grassi (2015)	Worldwide, technologies are often considered to be within the purview of men (Cecchini and Scott, 2003; Ashby et al., (2009) cited in Grassi (2015)) . Gender norms about men's control of technology, information, and knowledge limit women's opportunities to learn, use and benefit from technologies (Karlsson, 2007; Molony, (2005) cited in Grassi (2015)).
Household dynamics: Grassi (2015)	Men tend not to see the need to invest in technologies when women household members can do the work for free (Feder, Just and Zilberman, 1982; Knox, Meinzen-Dick and Hazell, 1999) cited in Grassi (2015)). They also tend to manage other family members' usage of technology, and often appropriate women's technologies either because they attribute a social importance to their usage, or because they recognize that there is an income-generating potential. Interestingly enough, this problem has been overcome in an Oxfam International project in Cambodia, which distributed pink cell phones to make them less attractive to men and ensure that the phone would remain in the hands of women (Oxfam, (2012) cited in Grassi (2015)).
Time availability: Grassi (2015)	The heavy burden of unpaid household responsibilities often leads to "time poverty" – the absence of discretionary time that women can dedicate to personal interests, paid labour, education, or other endeavours. Among those endeavours is learning skills that would allow them to adopt new technologies to improve their productivity or start a small business (Shelton and John, 1996; Karlsson and McDade, 2001; Hafkin and Taggart, (2001) cited in Grassi (2015)).
Physical challenges: Grassi (2015)	Most existing agricultural tools and equipment tend to be designed for men's physiques, with the result that they are often too heavy or too high for women to handle comfortably (Carr and Hartl, (2010) cited in Grassi (2015)). In many communities, women also make use of old and worn out hand tools that are easily found, but ultimately less efficient.
Social norms:	There is a wide range of social norms that inhibits women from accessing and adopting technology. Certain technologies or practices may not be considered suitable for them. For example, the use of long-handled hoes by women is not considered appropriate in West Africa ((IFAD, 1998) cited in Grassi (2015)). With specific reference to transport, restrictions on mobility and on associating with non-family members pose barriers to women's adoption of new technologies. Among some ethnic groups in Burkina Faso, women are prohibited from riding bicycles (Fernando and Porter, 2002). Security is also a major concern for women users of public transport, as they are especially vulnerable to violence or sexual abuse ((UNCTAD, 2011) cited in Grassi (2015)).
Financial and institutional constraints: Grassi (2015)	Women tend to lack the financial resources to use, rent or purchase established and new technologies (Zainudeen et al., (2008) cited in Grassi (2015)). The inability to borrow leads to a vicious circle: women cannot develop their skills, which prevents them from earning higher incomes, so they cannot afford the technologies that might boost them to the next rung on the economic ladder. Access to cash or credit is also restrictive for women's small businesses. Dissemination strategies that rely on individual entrepreneurs often put women and poor farmers at a disadvantage. For example, mills, graters and oil expellers are important labour-reducing technologies: rural mills can cut the required time for pounding or grating from hours to minutes. They are widely distributed, but while some are owned by community organizations or women's groups, most belong to individual male entrepreneurs, restricting access for poor producers who cannot afford to buy the services (World Bank, FAO and IFAD, (2009) cited in Grassi (2015)).
underserved by traditional extension. Grassi (2015)	Women have been underserved by traditional extension owing to their childcare responsibilities and the scarcity of their free time (World Bank & IFPRI, (2010) cited in Grassi (2015)). In turn, female farmers may not feel comfortable asking questions to male extension agents. Women may feel inhibited to speak freely in groups with men (Moore et al., 2001; Manfre et al., 2013; Meinzen-Dick et al., (2010) cited in Grassi (2015)).

Mobility: Grassi (2015)	Women often cannot travel long distances to attend extension sessions owing to time, cost and childcare responsibilities, as well as restrictions due to cultural norms.
Visibility:	Women's productive work is invisible and not targeted by extension services. The advice provided is therefore not tailored to their needs. Women are often not even considered as farmers and are therefore not approached by male extension agents. Extension and assistance is given to men even for tasks and crops managed by women, in the assumption that the information will be shared.
Information:	Lack of access to ICT or mobile phones restricts women's ability to find and access information. Information on improved technologies may not be widely disseminated, or the sales and maintenance structure may not be in place. Information is focused on a few areas that may not benefit all smallholders to the same extent, and complementary services may not be provided to implement the information.
ICT Grassi (2015)	Another important service is the provision of information and communication technology (ICT) to improve access to markets and supply chain management and to disseminate information about productive inputs and services. In view of existing limitations in reaching farmers in the developing world, ICT is recognized as a central component of agricultural outreach and information provision. Nevertheless, the gender digital divide in terms of ownership, control and independent access to computers (and even mobile phones) is still wide. The same resource restrictions that inhibit women's access to technology in general also affect women in terms of ICT. ICT use can decrease women's time burden directly: - It allows direct communication with clients, middlemen, markets and suppliers, decreasing time needed for travel. In Ghana, onion wholesalers known as "Market Queens" use mobile phones to coordinate supply among themselves and to reduce transportation costs (Overa, (2006) cited in Grassi (2015)). , saving time and increasing income. - Entrepreneurs in East Africa find that mobiles and computers help them combine business with domestic work, allowing them to work at home while running their enterprises. - Access to e-governance services increases efficiency and decreases time required to interact with government, apply for licenses, learn about regulations and procedures. (See, e.g., Nath, 2006 on India). - Mobile-phone based financial transactions provide access to financial services for those without a bank account, and save time by reducing travel to financial institutions (see T.S, 2013 on Kenya). Moreover, different payment schemes and options (such as pay as you go) have been developed and provide flexibility for lower-income households. Mobile-based transactions can also reduce safety risks linked to women travelling with cash when returning from long distance markets. - ICT is a particularly flexible and time-saving resource as it can allow women to access agricultural and productive information from home (Huyer, (2012) cited in Grassi (2015)). Mobile phones can give access to weather forecasts and help farmers to make decisions on when to sow (Lybbert and Sumner, (2010) cited in Grassi (2015) . As farmers deal with changes in climate and more variability in weather, local memory becomes a less reliable guide. ICT could be used to design early warning systems (accessible to rural women) for transmitting information on livestock disease outbreaks or locusts.

Enablers for women's access to and adoption of labour-saving technologies (based on Grassi 2015):	
Collective action and cooperatives Grassi (2015)	Can enable women (as well as men) to take advantage of technologies and services. E.g. collective ownership of grinding mills; women's self-help groups (can support entrepreneurship, financing, and market information services).
Energy. Grassi (2015)	Energy is a critical input for women's productive and reproductive work. Inefficient sources of energy are major causes of time poverty for women and girls.
LST for water efficiency Grassi (2015)	Irrigation projects can provide an efficient source of water for vegetable production, reduce the number of hours women spend in fetching water for production and domestic tasks, and make it easier for animals to be watered. Multi-use, multi-user and multi-purpose water systems can serve a wider range of community water needs, including but not restricted to agriculture, fishing, livestock watering, small business, kitchen gardening, and domestic tasks.
Feeder and main roads Grassi (2015)	Feeder and main roads can greatly reduce women's time burden and expand their work opportunities, especially when combined with accessible and affordable modes of transportation.
Gender and socio-economic analysis Grassi (2015)	Gender and socio-economic analysis is required to ensure that interventions do not inadvertently increase the labour and/or resources required, or undermine work valued by women. For example, the use of donkey carts for fuelwood collection in South Africa in fact resulted in women being required to travel farther to find wood, because their husbands appropriated the carts to collect and sell wood found closer to home (Fernando and Porter, 2002; Venter, Mashiri and Buiten, (2007) cited in Grassi (2015)).. A gender approach to transport planning can address and resolve this. Men should be sufficiently targeted in project design, as they are relevant to the gender dimension and part of the solution to women's work burden. This refers both to men's greater time availability in relation to women and to their role in women's access to and adoption of technology. Gender strategies that work with men as well as women can sensitize project beneficiaries to the concerns and needs of both.

Annex 6. FAO List of selected technologies, services and practices with labour-saving potential for women (Grassi et al (2015).

Table 2: List of selected technologies, services and practices with labour-saving potential for women

	Task/activity	Existing practice	Technologies, services and practices with labour-saving potential
HOUSEHOLD TASKS	Water collection	Walking to fetch water from potentially unsafe water source	- Improved household water sources (protected dug/shallow well and pump – protected spring – tube well/borehole & pump – public tap/ standpipe – roof rainwater harvesting – piped water into house, plot or yard – simple water filters)
	Fuelwood collection	Wood collected from communally owned resources	- Woodlots - Agroforestry practices - Improved fallow
	Cooking	Cooking on traditional open fires using traditional biomass or charcoal as fuel	- Fuel-efficient stoves, using traditional biomass or modern biofuels - Solar cooking - Small-scale low-cost power supplies, using diesel or renewable energy sources
	Care work	Looking after family while simultaneously undertaking essential domestic and productive tasks	- Rehabilitation/construction of care centre infrastructure - Support to local stakeholders to set up and run care services
AGRICULTURAL TASKS	Land preparation and cultivation	Manual land preparation, digging and weeding with simple tools and following traditional labour-intensive practices; often relying on local seeds	- Improved hoes for land preparation, planting and weeding - Tillage implements (steel mould-board plough – ripper tine – harrows and cultivators – ridgers and bed makers – levelling planks or blades) - Weed wipes and knapsack sprayers; fertilizer micro-dosers - Draught animal planers (DAPs) and weeders - Micro-irrigation (drip and sprinkler-based) for vegetable growers - Integrated pest management practices - Conservation agriculture (reduced tillage – semi-permanent planting basins – ridge, tined strip or zero tillage)
	Harvesting	Simple manual tools (knives and sickles) which are often heavy and/or worn out	- Improved hand tools for harvesting cereals (scythes – reaping hooks) - Motorized single-axle mowers and reapers for harvesting cereals - Draught animal-powered groundnut lifter
	Post-harvest (processing and storage)	Manual shelling, cleaning, drying and processing of crops; poor storage facilities and food packaging	- Small-scale low-cost power supplies - Draught animal-powered and motorized crop processing - Strippers and shellers (manual or motorized) - Threshers (manual or motorized) - Motorized cleaning/processing of grains and pulses - Crop processing (screw or hydraulic presses – cassava grinders) - Coffee hullers - Motorized rice hulling (rubber-roller huller – disc huller – polishers) - Motorized oil extraction - Solar drying & milling equipment (polyethylene covers) - Fish processing oven for fish drying, smoking and storing - Storage infrastructure and packaging materials (airtight storage bins)
	Transportation	Travel on foot; carrying loads on body	- Intermediate means of transport (donkey or other pack animals, wheelbarrow, cart, bicycle [with trailer] – small-scale motorized transport: single-axle tractors or motorized tricycles – yokes and collar harnesses for draught animals – Hippo water roller) - Affordable and safe public transport system - Improved paths and feeder roads
	Marketing	Limited utilization of ICT in acquiring market information	- Prepaid cards and mobile phone plans for weather forecasts, market price information, etc.

Source: FAO.

Annex 7. Domestic workloads (Bishop-Sambrook. C (2016))

Domestic task	Existing practice	Labour-saving technologies and practices
Water collection	Walking to fetch water from unsafe water source Improved household water sources	• Protected dug / shallow well and pump • Protected spring • Tube well / borehole and pump • Public tap • Rainwater harvesting from roof or ground • Piped water into house or yard
Firewood collection	Wood collected from poorly maintained communally owned resources	• Woodlots • Agroforestry • Improved fallow • Alternative fuels, such as waste materials and organic by- products • Fuel-efficient stoves
Cooking	Cooking on traditional open fires with traditional biomass or charcoal as fuel	• Fuel-efficient stoves, using traditional biomass or modern biofuels, such as biogas and ethanol ♣ Small-scale low-cost power supplies, using renewable energy sources
Food processing and preparation	Manually processing and preparing food	• Manually operated strippers and shellers • Manual and motorized threshers • Manual and motorized cleaners of grains / pulses • Solar drying and milling equipment • Manual crop processing • Draught animal-powered and motorized crop processing • Improved storage facilities • Electric milk churners • Small-scale low-cost power supplies, using renewable energy sources • Multifunctional platform (power supply and various associated tools to ease workloads)
Travelling and transporting	All travel on foot and carrying loads on body Intermediate means of transport	• Donkey, wheelbarrow, cart, bicycle (+ trailer) • Hippo water roller • Affordable and safe public transport system Improved paths and feeder roads
Care provision	Looking after infants, young children and the elderly, ill or disabled people while undertaking essential domestic and productive tasks, but foregoing project activities and more profitable regular productive work	• Rehabilitation / construction of care centre infrastructure • Support to local stakeholders to set up and run temporary or sustainable care services • Complementary awareness raising and training for both men and women on reproductive health, nutrition, hygiene, HIV/AIDS prevention, etc.

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Annex 8.2 Consultation.

Queries regarding activities/studies related to Women's Workload in Laos were made. The following list are those that responded to queries:

Adam Folkard	Consultant (Plan International in Lao PDR)
Emmanuel santoyo Rio	Consultant
Gill Grolimund	ADRA
Hongthong Sirivath	Village Focus International (VFI)
John Connell	Consultant
Khamla Phandanouvong	Consultant (GDA advisor/consultant)
Mette Boatman	Operations Director (Civitas Consulting)
Phounsy Phasavaeng	Former CARE program manager; Former Plan Gender advisor
Ranjan Shrestha	Manager (Nutrition) (SNV)

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