TPGS On-farm Nutrition-Sensitive Intervention Protocol

1. Background

According to the 2021 Global Nutrition Report, Ethiopia has made relatively encouraging progress toward reducing the stunting rate, although 36.8% of children under five are still stunted. Wasting for children under five seems to decline even if 7.2% of children under five are still wasted. CGIAR has introduced over 32 initiatives to contribute to target countries' food and nutrition security. Sustainable Animal Productivity for Livelihoods, Nutrition, and Gender Inclusion (SAPLING) is one of the initiatives led by ILRI that strives to integrate genetics, poultry health, and feed with feasible business models to facilitate access to finance and markets. SAPLING is implementing its activities in Ethiopia, Kenya, Tanzania, and Vietnam. The SAPLING initiative's first human nutrition activity is to promote animal-source food consumption. The on-farm nutrition-sensitive intervention aims to apply an integrated nutrition education package, promote the consumption of LDFs, and improve their nutritional outcomes in randomly selected households in Ethiopia, Kenya, Tanzania, and Vietnam.

GENERAL INFORMATION	
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Principal Investigator: Tadelle Dessie	
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2. Specific Aims

Nutrition-sensitive interventions in key sectors such as agriculture can advance progress in nutrition by addressing the underlying determinants of poor nutrition and enhancing the coverage of nutrition-specific interventions (Ruel et al., 2013). Agriculture can impact nutrition through multiple pathways, including increased availability of food through household production, increased household incomes through agriculture-related activities, changes in women's time use, empowerment, or status within the household, and environmental exposures as a consequence of agricultural activities (Gillespie et al., 2012; Webb, 2013).

Tropical Poultry Genetic Solutions (TPGS) is a platform for testing and identifying high-producing farmer-preferred poultry genotypes. Improved poultry genetics will be accessible for

smallholders to improve household income and nutrition and contribute to women's empowerment in Africa, Asia, and beyond. TPGS has been implementing its activities through its predecessor, the African Chicken Genetic Gains (ACGG) project. ACGG has been operational in Ethiopia, Tanzania, and Nigeria with funding from the Bill & Melinda Gates Foundation (BMGF). ACGG has successfully baselined a total of 3665 farmers; engaged 6017 households in the testing of approximately 154 899 birds of 13 strains on-farm; tested 5714 birds (12 strains) on-station. The ACGG model has led to a significant reduction in chicken mortality (with the dissemination of vaccinated and brooded dual-purpose chicks) and increased productivity in terms of live body weight at 17 and egg production compared to indigenous breeds, which were kept with minimum support services. ACGG has also developed robust public-private partnerships (PPP) to enable sustainable chicken multiplication and delivery of farmer-preferred strains (e.g., Kuroiler, Sasso, and Noilier).

Having reached its milestones much earlier than initially targeted, successful practices from ACGG were adapted to several African countries, including Kenya, Ghana, and Zimbabwe, from 2020 onwards with the new TPGS platform. The achievements of the ACGG were recognized by multiple international research-for-development partners. In 2020 a sister project, the Asian Chicken Genetic Gains (AsCGG), was kicked off, with investments from the Australian Centre for International Agricultural Research (ACIAR), to enhance the production and productivity of smallholder poultry farmers in Cambodia, Myanmar, and Vietnam. Since 2015 the number of investing and non-investing TPGS partners has increased from 5 to 121. TPGS has maintained and strengthened existing partnerships with international poultry genetics companies (such as Sasso/Hendrix Genetics and Kuroiler/Kegg farms), national/regional companies (such as Ethio-Chicken, Silver lands Ltd, AKM Glitters and Amo Farms), and public institutions in Ethiopia, Nigeria and Tanzania while forging new ones with national research institutes in Cambodia, Kenya, Ghana, Vietnam, and Zimbabwe.

The Agriculture to Nutrition (ATONU) project had been aligned with ACGG to promote the consumption of chicken meat and eggs at household level. ATONU's nutrition sensitive interventions contributed to better outcomes in terms of consumption of meat and eggs. The overall average household dietary diversity score that was about 4.13 during baseline, increased to 4.64 at the end-line. Based on the 7 days recall measure, the proportion of women that fulfilled minimum dietary diversity increased from 27.9% to 43.0%. TPGS with this experience is aimed at improving the nutritional status of smallholder farmers in the project areas.

TPGS works to improve the performance of existing tropical poultry smallholder value chains, and it is the leading chicken genetics-focused long-term project ever implemented in Africa and Asia. Its achievements have been lauded as a success by its investors and the research and development community. Its approach considers agroecological, socio-economic and cultural diversity across geographies and follows data-driven comparison of the performance of chicken strains.

TPGS will continue to mobilize its expertise and resources in a research-for-development (R4D) framework to

(a). Provide alternative high-producing dual-purpose poultry genetics and technologies.

(b). Develop additional breeds that are more productive, adapted to different agro-ecologies and are farmer preferred.

(c). Foster more inclusive poultry market chains with key involvement of the private sector.

(d). Improve gender equity and women empowerment.

(e). Promote the consumption of chicken meat and eggs and enhance nutrition security.

TPGS with its on-farm chicken performance testing aims to promote the consumption of chicken products among household members and thereby enhance the nutritional outcomes of the most disadvantage segments of the household members notably women, children, and the elderly.

1. To estimate the effect of an intervention to increase chicken production on dietary diversity among women of reproductive age and children under two years of age.
2. To estimate the effect of a behaviour, change communication (BCC) intervention focusing on nutrition education, women's empowerment, and use of income for nutrition on dietary diversity among women of reproductive age and children under five years of age in the context of an agricultural program promoting chicken production.
3. To estimate the effect of an intervention promoting home gardening on dietary diversity among women of reproductive age and children under two years of age in the context of an agricultural program promoting chicken production integrated with a BCC intervention on nutrition education, women's empowerment, and use of income for nutrition.

Aims 1-3 will be achieved by comparing the arm receiving the poultry production, BCC, and home gardening interventions with the arm receiving no poultry production and BCC

interventions. For this purpose, there will be two treatment arms: intervention and control in each project village.

3. Significance of the research, and how it will add to existing knowledge

While the link between agriculture and nutrition seems intuitive, direct evidence linking agriculture and nutrition programs is weak(Webb, 2013). In fact, the intense focus of many agricultural programs on increasing staple food production can negatively impact nutritional security(Dury et al., 2015). To fulfil their potential for reducing poverty and hunger, agricultural development initiatives must specifically incorporate nutritional goals (Ruel et al., 2013). Agriculture can impact nutrition through multiple pathways including increased availability of food through household production; increased household incomes through agriculture-related activities; changes in women's time use, empowerment, or status within the household; and environmental exposures as a consequence of agricultural activities (Gillespie et al., 2012; Webb, 2013). Reasons for the decreased egg consumption in rural populations include a decline in backyard poultry farming, the high cost of eggs, and lack of nutritional knowledge.

TPGS nutrition sensitive intervention seeks to answer the question of how best practices in nutrition and health can, including behavior change, be integrated into agricultural programs and projects to improve the nutrition status of women and young children. The project will design, pilot, and implement a range of interventions to improve nutritional outcomes. The interventions will address the variety of social, economic, and environmental contexts found in African and Southeast Asian agriculture and there will be a specific focus on women of child-bearing age and young children in rural households, where the high nutritional demands of pregnancy, development, and early childhood must largely be met through food grown or income earned on family farms. Evaluation of these interventions would demonstrate the potential for nutrition-sensitive approaches in agriculture to impact nutrition in vulnerable populations.

4. Study design

This study will be conducted in SAPLING/TPGS program areas in Ethiopia, Kenya, Tanzania, and Vietnam. The selection of households to participate in the nutrition activity is a combination of applying criteria for participation in the SAPLING/TPGS on-farm chicken performance testing (OCPT) and an element of self-selection by participants. This protocol describes how participants in villages within proposed performance testing sites (PTS) should be selected to ensure 'statistical

representativeness' and meet ILRI's institutional ethical standards. The selected households will be exposed to nutrition activities.

A cluster-randomized study design will evaluate the effect of the on-farm nutrition-sensitive and on-farm chicken performance testing (OCPT) interventions on the primary outcome of dietary diversity among women of reproductive age and children under five years old in smallholder poultry-producing households. Secondarily, the study will also examine the effect of the interventions on women's and young children's nutritional status. The clusters will be villages with the lowest government administrative structure in Ethiopia, Tanzania, and Kenya. Villages participating in the OCPT intervention will be randomly assigned to one of two treatment arms: (1) OCPT alone, the introduction of improved and adapted chickens to farmers under the Tropical Poultry Genetic Solutions (TPGS) Program, or (2) OCPT+NSI, the introduction of TPGS chickens and integrated nutrition education packages. Using the same sampling frame of villages used by the TPGS OCPT program, non-OCPT villages will be selected for the third arm, (3) control (no intervention). Data will be collected at two time points: baseline prior to the start of NSI interventions and endline after completion of the interventions.

Research questions

1. How best practices in nutrition and health, including behavior change, can be integrated into agricultural programs and projects to improve the nutrition status of women and young children?
2. What are the best delivery mechanisms for educating farming households about nutrition?
3. What are the gaps in nutrition among communities, women, and children?
4. How does tailored nutrition education impact household consumption patterns, especially consumption of animal source foods?
5. What is the impact of disseminating agriculture and nutrition information on household consumption and production patterns?

5. Summary of criteria for household participation in the on-farm study:

- Chicken-keeping experience for at least two years.
- Presence of a woman at childbearing age in the household
- Currently keeps not more than 50 adult chickens (this criterion is included mainly to avoid mixing of eggs during eggs data collection and not to compromise farmers' ability to provide supplementary feed and other resources)
- Willingness to accept on a chance basis a flock of 25, 50, or 75 birds of a randomly selected strain (only one strain of one of the three flock sizes will be assigned per household)
- Commitment to provide night shelter at a minimum.

- Commitment to provide supplemental feeding apart from scavenging.
- Willingness to take part in TPGS-related discussions.
- As part of the data collection, allow identification (tagging), vaccination, and treatment of introduced and existing birds.
- Willingness to participate for a minimum of 72 Weeks in data collection.
- Willingness to participate in the monthly nutrition education sessions.

The following process should be followed for the selection of on-farm beneficiary households in OCPT:

1. In collaboration with local administrative units and the district office of agriculture, the regional project coordinator/co-coordinators prepare a list of all households to draw eligible households in each village.

2. As per the TPGS criteria, the aim is to **randomly** select **36** chicken-keeping households from the list in each village. The farmers will then be asked if they are willing to participate in the on-farm testing. If yes, they will sign a written consent form, and their name will be entered into the 'hat' through random household selection. Social and behavioural change communication (SBCC) will be applied to these households to promote animal-source food consumption. We suggest targeting at least 15% of the sample household to be women headed.

The households shall be invited to a community meeting during which the following shall be discussed:

- Objectives of the SAPLING/TPGS on-farm chicken performance testing (e.g., contributions to income, household nutrition, employment)
- Benefits to on-farm participating households and risks associated with the test (e.g., performance can be lower than existing flocks, and the animals may require higher resources in terms of feed and health management). The details of the risks are outlined in Consent Form (*to be attached*).
- Random distribution of one of the three chicken strains to household
- The numbers of birds/flock sizes to be assigned randomly to a household
- Activities that will be undertaken – the need for cooperating with enumerators weekly during data collection and monitoring

3. If more than 36 households' consent to participate, 36 names will then be randomly drawn out of the hat (in the presence of the farmers who consented).

4. In each village, both digital and paper-based nutrition education will be provided by nutrition experts. Participants within and from the adjacent villages will be invited to attend the sessions.

5. To further promote the consumption of chicken meat TPGS chicken meat carnival will be organized in each village every three months.

Experimental design for the Nutrition component

A cluster-randomized study design will evaluate the effect of the on-farm nutrition-sensitive interventions on the primary outcome of dietary diversity among women of reproductive age in smallholder poultry-producing households. Secondarily, the study will also examine the effect of the interventions on women's and young children's nutritional status. The clusters will be villages with the lowest government administrative structure in Ethiopia, Tanzania, and Kenya. Villages participating in the on-farm chicken performance testing (OCPT) component will be randomly assigned to one of two treatment arms: (1) TPGS alone, the introduction of improved and adapted chickens to farmers under the Tropical Poultry Genetic Solutions (TPGS) Program, or (2) TPGS plus nutrition education (TPGS+NSI), the introduction of TPGS chickens and integrated nutrition education packages. Using the same sampling frame of villages used by the TPGS OCPT program, non-OCPT villages will be selected for the third arm, (3) control (no intervention). All TPGS households (36 per village) will be involved in the nutrition component in treatment arm 1 or 2. An equivalent number of households (36 per village) will be selected, following the same criteria for selection as for TPGS, to be in treatment arm 3. Data will be collected at two points: baseline before the start of nutrition-sensitive interventions and end-line after completion of the intervention.

Sampling in Ethiopia, Kenya, and Tanzania:

			No. villages per OCPT (no. HH per village)		
Country	**Region/County**	**OCPT Site**	**Chicken +TPGS**	**Chicken +TPGS+ Nutrition**	**Control**
Ethiopia	Amhara	Bahir Dar Zuria	1 (36)	1 (36)	1 (36)
Ethiopia	Amhara	Menz Gera Midir	1 (36)	1 (36)	1 (36)
Ethiopia	Oromia	Wolmera	1 (36)	1 (36)	1 (36)
Ethiopia	Oromia	Barek	1 (36)	1 (36)	1 (36)
Ethiopia	South	Kembata Tembaro	1 (36)	1 (36)	1 (36)
Ethiopia	South	Konso	1 (36)	1 (36)	1 (36)
		Ethiopia Total	**6 (216)**	**6 (216)**	**6 (216)**
Kenya	Kakamega	TBC	1 (36)	1 (36)	1(36)
Kenya	Bomet	TBC	1 (36)	1 (36)	1(36)
		Kenya Total	**2 (72)**	**2(72)**	**2 (72)**
Tanzania	Lindi	Mtala	2 (72)	1 (36)	2 (72)
Tanzania	Lindi	Ruangwa	1 (36)	2 (72)	1 (36)
Tanzania	Kilimanjaro	Siha	1 (36)	2 (72)	2 (72)
Tanzania	Kilimanjaro	Hai	2 (72)	1 (36)	1 (36)
		Tanzania Total	**6 (216)**	**6 (216)**	**6 (216)**

In Ethiopia, 648 households will be enrolled in the study at baseline. Among these, 216 households belong to the TPGS arm, 216 belong to the TPGS+NSI arm, and 216 belong to the control arm. The same procedure will be applied to Kenya and Tanzania, although due to fewer sites (OCPT site), the design is balanced to have 6 villages per arm, per country. Baseline data collection is expected to start at the end of June 2023. The household selection is already underway, considering the household selection framework. Based on experience and budget limitations, household selection varies from country to country. The nutrition component of TPGS is overlaid on the on-farm chicken performance activity. TPGS's activity, in turn, relied on earlier findings of the African Chicken Genetic Gains (ACGG) project, which identified productive and adaptive breeds. The TPGS on-farm chicken performance testing sample size is 36 households per village and 12 villages per country (see below). For the nutrition component, we calculated the number of villages required per treatment arm; assuming we have 36 households per village, we used dietary diversity as the main outcome indicator to base the sample size (see below). The survey for the nutrition component is applied at baseline and end line and includes all questions related to the nutrition component and the overall OCPT activity.

The livelihood indicators we will use for the on-farm chicken performance study are driven by the number of eggs and amount of meat produced, and our sample size justification (see summary table below) for IACUC focuses on justifying that we have enough households to compare strains and flock sizes for productivity traits at country level.

	Sample Size Calculations for TPGS (OCPT)			Nutrition component
Indicator	**Egg production (/ hen/year)**	**Weight at 12 weeks (male)**	**Survival to 26 weeks**	**Dietary Diversity (proxy HDDS 0 – 1)**
'Significant' difference between any two strains*	0.2 *Expressed as % of combined mean of 180; i.e. 20% = 36 eggs difference	0.3 *Expressed as % of combined mean of 1.75kg; i.e. 30% = approx. 0.5kg difference	0.3 *Assuming 1st strain = 65% and 2nd strain = 95%	0.4
Expected variation	0.04 assuming CV = 20%; s.d. = 20% of mean[1]	0.09 assuming CV = 30%; s.d. = 30% of mean[2]	*n/a - note for above would prefer a smaller difference in mortality to be significant (e.g., 75% vs. 95%), but this would raise the number of villages required to 23*	*0.4*
Unadjusted number of birds per strain x flock size	16	16	24	40 Households
Number of household per strain x flock size per village (for analysis)	4	4	4	36
Intra-cluster correlation within villages (ICC)	0.3	0.3	0.3	0.1
Design Effect	1.90	1.9	1.9	4.5
N adjusted	31	31	46	180
Number of villages required PER COUNTRY (rounded up)	8	8	12	5

[1]CV for egg production in a commercial environment is around 5% but assuming much higher for on-farm

[2]CV for growth rate in commercial environment around 15% for low-density systems, likely higher CV for on-farm

Equations used: 2-sample normal calculation at 5% significance level with 80% power for eggs and weight; 2-sample binomial equivalent for survival.