Expanding the Promotion of Local Innovation For Food Security and Healthy Nutrition Project (ELI-FaNS)

REPORT ON PARTICIPATORY INNOVATION DEVELOPMENT (PID) PROCESS DOCUMENTATION ON LOCAL INNOVATIONS

Innovator measuring materials for her dawadawa condiment innovation (left), Joint monitoring of compost experimental fields with innovators (right)

Compiled by

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ACRONYMS

ACDEP:	Assoc. of Church Dev't Projects
ARD:	Agric. Research and Development
ARI:	Animal Research Institute
CEAL:	Centre for Ecological Agric. And Livelihoods
CP:	Country Platform
CSIR:	Council for Industrial and Scientific Research
DoA:	Department of Agriculture
LI:	Local Innovation
LISF:	Local Innovation Support Facility
MoFA:	Ministry of Food and Agriculture
MSP:	Multistakeholder Platform
PAS M7:	Presbyterian Agric. Station, Mile 7
PID:	Participatory Innovation Dev't
PROLINNOVA:	Promoting Local Innovation in ecologically-sustainable Agric & NRM
SARI:	Savanna Agric. Research Institute
TZ:	*Tuo Zaafi* (local Ghanaian food)
UDS:	University for Dev't Studies

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Lastly, we acknowledge the relentless support of all the technical team members to the ACDEP project team, farmer innovators, and the multi-stakeholder institutions at the learning sites in facilitating PID, local innovation, capacity building, and learning processes.

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INTRODUCTION

"Expanding the promotion of local innovation for food security and healthy nutrition to strengthen resilience with a focus on women" has the following three objectives:

1. Small-scale farmers (especially women & youth) actively innovate to improve the food & nutrition security and livelihoods of rural communities;
2. Researchers, university lecturers & other relevant decision makers at local, national, subregional & regional levels pay more attention to participatory innovation development (PID) approaches and engage in activities to promote PID;
3. Prolinnova structures at all levels are functional and convincingly promote farmer-led joint innovation at local, national & subregional/regional levels.

Grassroots-level activities are being implemented in ten action-learning sites in five countries, namely, Benin, Burkina Faso, Ghana, Kenya, and South Africa. In all the learning sites, the focus is on promoting farmer-led participatory innovation in production, processing, marketing, and consumption of crop and/or livestock products.

In Ghana, the project is being hosted and coordinated by the Association of Church-based Development Projects

(ACDEP) and implemented in rural communities in partnership with two local NGOs. These are the Presbyterian Agricultural Services (PAS Mile 7) based in Tamale and coordinating field implementation in the North-East Gonja District (North-East Gonja action learning site) and the Centre for Ecological Agriculture and Livelihoods (CEAL) based in Walewale town and coordinating implementation in West Mamprusi Municipality (Walewale action learning site). Other key local stakeholders in the project in each learning site include local government authorities (District Assemblies), Department of Food & Agriculture, Forest Services Department, Traditional rulers, and Farmers groups. The Savanna Agricultural Research Institute (CSIR-SARI), Animal Research Institute (CSIR-ARI), University for Development Studies (UDS) are additional key stakeholders providing technical support and learning from the project approach.

Project approach

The project uses the farmer-led research approach, also known as the Participatory Innovation Development (PID) approach, to involve researchers, extension agents, farmers, and other experts in joint efforts to explore and further improve farmers' innovations to increase the benefits from the innovations. In the PID processes, the innovators and other farmers in the community play the lead role in planning, implementing, evaluating, and sharing the process and outcomes. Formal researchers, development workers, and other experts facilitate the PID processes as co-researchers. Two local multi-stakeholder platforms (MSPs) formed under the project at the learning sites also play roles in the PID processes, with regard to the selection of innovations for improvement, planning, executing, evaluating, and sharing the PID outcomes. They also offer technical support and promote learning, advocacy, and institutionalisation of the local innovation and PID approach. The Technical Support Team based in Tamale, made up of former agricultural researchers, Advisory services, University lecturers, and gender and women development experts, provides additional capacity and backstopping support to the PID processes.

Under the project, 3 prioritised innovations (one male, 2 females) successfully underwent farmer-led joint experimentation or PID in the two learning sites during the project period. This report describes the PID processes and outcomes achieved on the cases indicated below:

1. Joint experimentation with a formal researcher to improve 'quick-action' compost innovation of Madam Rahina Yussif in West Mamprusi District (Walewale site)

2. Joint experimentation to improve the efficacy of *paliga* (*securidaca longepedunculata)* roots for controlling pests in stored grains by Sulemana Osman in the North-East District (North-East Gonja site)

3. Madam Asimawu Kasim joins hands with a nutrition expert to improve the nutritional value of her *dozim chisi* dawadawa condiment in North-East Gonja District (North-East Gonja site)

JOINT EXPERIMENTATION WITH FORMAL RESEARCHER TO IMPROVE 'QUICK-ACTION' COMPOST INNOVATION OF MADAM RAHINA YUSSIF IN WEST MAMPRUSI DISTRICT OF GHANA

By Dr Mutari Abubakari (CSIR-SARI), Issifu Sulemana (CEAL NGO), Scholastica Atarah (Dept of Agric), Denisia Abulbire and Joseph Nchor (ACDEP)

1.0 Name and general characteristics of the innovator

Madam Rahina Yussif is a 45-year-old smallholder farmer and innovator from Kukua community in the West Mamprusi District in the North East Region of Ghana. With no formal education, the innovator is married with 5 biological children and 2 grandchildren. She cultivates maize, groundnuts, soybeans, and millet on a 2-acre land for household consumption, whilst selling the surplus produce for her financial needs. She also rears small numbers of sheep, goats, fowls, and guinea fowls for protein, income, and cultural purposes. Through trainings provided by extension officers from the Department of Agriculture, she has developed immense skills in sustainable farming practices, which often give her high crop yields. She is a member of the Village Savings and Loans Association (VSLA) self-help women's group in Kukua.

Rahina and the materials used in preparing her compost (Photo: Ibrahim Adam, CEAL officer)

2.0 Brief description of the innovation being further developed

Compost preparation is a common practice among farmers in the West Mamprusi District to address low soil fertility in order to improve crop yields. Unlike the conventional composts being prepared and used by many smallholder farmers in the locality, Madam Rahina's compost differs in its composition and provides a more rapid effect on improving soil fertility, giving her much higher yields than the ordinary composts she had used years before. She developed her innovative compost by self-experimentation with different household and agricultural wastes through adding liquid wastes from shea butter extraction, liquid waste from dawadawa (*Parkia biglobosa*) fruit husks, and human urine to prepare the compost. She employs the following procedure in preparing her compost:

1. Sorting and separation of plastic and other non-degradable waste from the household and agricultural wastes
2. Crop residue or grasses (carbon source) are shredded/ chopped into smaller pieces and arranged in layers, or mixed uniformly with the largest proportion spread on the ground.
3. She adds animal droppings, either from chicken, goats, or cattle, to the materials indicated under *1* and *2*, and mixes them all together

4. She adds ashes from household cooking to make up a potash component.
5. She then adds water, the liquid from dawadawa fruit husks, and the liquid waste from shea butter extraction *(kpabulugu*) for preparing the compost.
6. Lastly, she adds normal human urine to the material so far to quicken the decomposition process.

The shea butter liquid waste helps to retain and hold moisture in the soil. The dawadawa husk liquid waste soaks the materials, improves the fertility content, and catalyzes the release of nutrients from the compost.

3.0 Why and how the innovation was identified and selected for PID

The soils in the Kukua community are highly exhausted because of continuous cultivation and frequent use of chemical fertilizers. Also, chemical fertilizers have become scarce, expensive, and undermine ecological sustainability. This innovation was selected because of its potential to contribute to food and nutrition security in northern Ghana by addressing the soil fertility problem. The selection of the innovation was done by the local MSP team jointly with the community members based on the following key criteria:

i. High agro-ecological importance and potential to address the rapidly declining soils;
ii. High adoption potential and scalability if further developed, widely disseminated, and promoted;
iii. Potential to improve crop productivity and boost food security;
iv. The materials used for the innovation are cheap and available in the community for most farmers, as compared to chemical fertilizers.
v. As a female-led innovation, it will promote gender equality and further bolster the immense contribution of women to household food security.

4.0 Objectives of the PID and benefits to be derived

The innovator had developed an improved compost, which gave her higher yields than the normal composts she and other farmers had used before. A joint experimentation with formal researchers through field trials was therefore required to validate the innovator's claim, quantify the materials components. This will enable its further development and promotion to address soil fertility decline and increase crop yields to improve food security in the community and beyond. The specific objectives of the PID were:

a. To conduct field trials to validate and improve the efficacy of the compost.
b. To standardize the product for future commercialization by the innovator, and to enhance adoption by farmers and relevant stakeholders, such as extension agents, researchers, and large-scale commercial farmers
c. To improve the knowledge and skills of the innovator and group members on organic soil fertility management practices and farmer experimentation.

The anticipated benefits/outcomes from the PID process are: i) improved compost for its wider use in addressing soil fertility to increase crop yields; and ii) increased knowledge in soil fertility management, quality compost preparation, and proper application to crops.

5.0 The PID process

5.1 The main activities undertaken

Dr. Mutari Abubakari, a research scientist from the Council for Scientific and Industrial Research -Savannah Agriculture Research Institute (CSIR-SARI), was the lead research facilitator for the PID process. He was supported by the staff of the Centre for Agriculture and Ecological Livelihoods (CEAL), which is the lead partner NGO for the Walewale learning site, members of the local multistakeholder platform (MSP), including Scholastica Atarah of the District Department of Agriculture, and the ACDEP project team. The experimentation centred on Innovator Rahina Yussif and 11 other farmers in her community who participated in the field experiments. The joint experimentation took place in the Kukua community in the West Mamprusi District from November 2023 and ended in March 2025. CEAL coordinated the field processes and stakeholders, while ACDEP provided required logistics and inputs through the ELI-FaNS project.

The following key activities were implemented in the PID or joint experimentation process.

- Planning and design of PID process with Innovator, MSP, CEAL staff, lead researcher. This included developing the research design, protocol/treatments, and methodology.
- Community sensitization on the PID process and mobilization of the experimental group led by CEAL and ACDEP
- Gathering of inputs, materials, and tools by the lead innovator, group, and CEAL
- Training on compost preparation and organic soil fertility management practices
- Provision of additional materials and inputs to innovators to prepare compost for the experiments

- Conduct of the PID process by CEAL, farmers, and the lead researcher:
    - Land preparation and field demarcation of 10m x 10m by each farmer
    - Compost application before planting
    - Sowing of maize seeds of the same variety
    - Farm sanitization management, pests, and disease control
    - Data collection, including photos and observations
    - Harvesting and post-harvest management
    - Drying, weighing, and measurements
- Field documentation of processes and observations, data analysis by CEAL, and the lead researcher
- Preparation of research report
- Conduct of community participatory evaluation and sharing of the PID results by lead facilitator, CEAL, and ACDEP
- Conduct of cross-community sharing of the innovation and PID outcomes

5.2 Experimental procedure

Experimental Materials

The main materials for this experiment included: Dawadawa husk waste, Shea butter waste, grasses, wood ashes, mixed animal droppings, and human urine. Other items were hand gloves, Wellington boots, shovels, nose masks, a big water drum, *'kuffuor'* gallons, and improved maize seeds (*cv wang-dataa*).

Experimental Protocols and Replications

Twelve (12) farmers (67% women) selected for the PID process were supported to build different formulations of composts for the experiments. They were put into four experimental groups of 3 farmers each to formulate the different composts (protocols) as follows.

Group 1: Grasses, ashes, animals' droppings, urine, shea butter, liquid waste, dawadawa husk liquid waste. This is the innovator's own compost composition

Group 2: Grasses, ashes, urine, animal droppings, and shea butter liquid waste. This group is the innovator's composition without dawadawa husk liquid waste.

Group 3: **G**rasses, animal droppings, ashes, dawadawa husk, liquid waste, and urine. This category also comprises of the innovator's composition without the shea butter liquid waste

Group 4: Control treatment (the conventional compost): Grasses, animal droppings, and ashes**.**

Methodology

The 12 farmers were given basic training by the lead researcher to understand the experimentation they were to undertake. The training included the materials gathering, materials combinations and measurement, the weekly turning and watering of the composts, and checking of microbiology activity, etc., and how to work together in the small groups. The training enabled them to build enough composts of different compositions as indicated for the experiments. To this effect, half a ton of compost was built by each farmer for the experimentation. In order to help the 12 farmers meet their required quantities of compost, each farmer was assisted with tools such as a pair of Wellington boots, hand gloves, nose masks, a shovel, a garden fork, and a cutlass. Each farmer was also supplied with improved maize seeds for the experiments. All the tools and inputs were provided through the Local Innovation Support Facility (LISFs) under ELI-FaNS.

Layout of the field experiments:

CEAL's technical team trained and supported the 12 farmers to demarcate and prepare (minimum tillage technique) 10m x 10m plots within their farms for the experiments to be planted with the improved maize. The farmers were then trained and supported to measure and bag their compost into 100kg per bag. This was followed by the first compost application using the *Zai* method, or spot application of 1Kg of compost to each hole prior to planting the seeds. Experimental data on activities and quantities were regularly recorded in a field notebook.

Demonstrating the composts preparation

Innovator shows her improved compost

Training session by lead researcher

Innovator's experimental plot

Farmer field day

A field day was organized on 30 July 2024 to interact with the experimental group and other farmers and share observations and learning from the experimental fields. The team consisted of ACDEP staff, CEAL staff, the lead researcher, and the farmers. Four fields were visited, and these had varying outlooks. Generally, the fields were not weedy, some of the plants looked healthy, but the plant stand was poor, and the fields were deprived of moisture due to a drought situation. Incidence of fall army worm (FAW) was also noticed in all the fields, and CEAL assisted the farmers with chemicals to spray them.

5.3 Data collection, analysis, and results from the experiments

The team visited the fields regularly to collect data and monitor the progress. The visits entailed documenting the quantities of the different materials used, the experiences and knowledge gained by experimental farmers thus far, and the challenges encountered by each farmer. At the end of the field experimentation, the data collected throughout the experiment were analysed by the lead researcher to produce the results.

The results of the experimentation are presented in the table below, capturing the number of cobs and cob weight in kilograms (kg). The cob weight was transformed to a hectare basis for ease of interpretation.

Table 1. Yield components of maize under the various compost treatments

Group	Treatment	No. of Cobs (10mx10m)	No. of Cobs (ha)	Grain weight (kg/100m^2)	Grain weight (kg/ha)
1	Innovator's full compost complement	628	62,833	38.3	3,833
2	Innovator's full complement minus dawadawa waste)	503	50,333	34.0	3,400
3	Innovator's full complement minus shea butter waste)	386	38,567	27.7	2,767
4	Normal compost/conventional compost	275	27,500	22.5	2,250
Mean		**448.1**	**44,808**	**30.6**	**3,062**
LSD (5%)		**NS**	**NS**	**10.89**	**1,088.8**

The outcome of the experimentation was analyzed scientifically, and the mean values were determined by the Least Significant Difference (LSD). The results (Table 1) indicated that the number of cobs per unit area did not vary significantly among the various treatments, even though the innovator's treatment had more cobs than the other treatments. The least number of cobs was realized in the normal compost treatment. Differences in grain weight were significant between the innovator's treatment (being higher) and the rest of the treatments, with the least being the normal composting. It is recommended that nutrient analysis be carried out on the various composts to assess the actual impact of the application on crop yield.

Description of the Results

- The results revealed that the innovator's full complement proved most effective in producing the most yields, followed by the innovator's complement without dawadawa husk wastes, then followed by the complement without shea waste, and lastly by the conventional compost.
- The findings thus showed that the innovator's full complement proved the most effective in addressing soil fertility
- The compost built by each group was bagged and weighed on a scale provided by the CEAL team. This addressed the objective to standardize the special compost. They were then taken to the

individual farms of the experimental farmers for application.

- According to the researcher, the best method of application of the compost for the experiment was the Zai method of placing compost in small depressions created around the planting holes before sowing the seeds. The method allowed each seed planted in the dug holes to absorb every nutrient the compost provides, and also absorb what is required from the added fertilizer. The method has the ability to restore degraded soil, catch water from the rains, and concentrate compost.

Experimental group exhibit

produce from their experiments

Produce from lead innovator

6.0 Participatory evaluation and sharing of the PID process, findings /results

Following the completion of the experiment process, a participatory evaluation and sharing session was held in March 2025 with the 12 experimental farmers and other community members. The event enabled a sharing, participatory evaluation, and learning on the process, the results, and the outcomes. The farmers provided feedback on observations, views, challenges, and recommendations.

The findings from the lead researcher, shared and validated by the experimental farmers, include

- The group that used the innovator's full complement produced the most yields, with the other complements producing lower quantities.
- The innovative compost was indeed capable of addressing the first objective, which aimed to address soil fertility and improve yields.
- The farmers gained more knowledge in their composting activities, which would potentially lead to a positive impact on food security.

Feedback from the community members and experimental farmers

- The experimental group acknowledged that the innovator's practice was comparatively better in terms of yields.
- Farmers stated that their participation in the process and seeing the results motivated them to want to adopt the innovation, even if it means doing it on a small scale effectively.
- The innovator encouraged other farmers, especially women and smallholder farmers, to practice composting and the Zai method for greater yields.
- They observed that the variety of maize used for the experiment was nutritionally superior to the local varieties when used in preparing food.
- Many of the community members expressed interest in adopting and using the innovator's special compost on their farms.
- Experimental farmers expressed their gratitude to the project team for acknowledging farmers as intelligent researchers who go the extra mile to innovate to find solutions to their own problems. They stated that they felt more involved with the farmer-led approach as it provided them with the opportunity to generate solutions and share knowledge using available local materials.

7.0 Key challenges during the PID process

- Transportation of compost to the farm was a challenge among all 12 experimental farmers, as most of them had no means of conveying the heaps of compost from their homes to the plots.
- The accuracy of measuring the amount of source materials used for the composting was a challenge due to their illiteracy status.
- The emergence of a drought caused a prolonged dry spell, which affected fields and plant productivity. As a result, farmers experienced poor germination, leading them to refill up to three times after sowing. This affected plant population per field and, thus, is also believed to have affected the possible total yield.
- The prevalence of fall armyworms affected the productivity of the crops despite the application of pesticides
- Insufficient tarpaulins for covering composts, which affected the farmers on two levels. Firstly, the rate of decomposition of the compost as entrapping heat is a key element in decomposition. Secondly, insufficient tarpaulins exposed the compost to domestic birds searching for earthworms, maggots, and termites, which are agents of decomposition.
- During the compost building, farmers faced the challenge of sourcing raw materials, specifically animal droppings. This increased their costs as the experimental farmers had to buy it from Fulani herdsmen.

8.0 Sharing of the experience and results/findings/outcomes of the PID process:

The innovator has shared her innovation on different occasions at various events. Firstly, during a community exchange visit for innovators at the Walewale learning site. She and her group experimenters also showed the PID experimental trials and experiences to partners of Prolinnova Ghana during a PID training facilitated by Prolinnova International Support (IST) in August 2024. After concluding the experiment, the innovator shared the innovation, her experience, results, and newly acquired knowledge with her community and with 3 other communities in the Walewale learning site. She also participated in a Farmer Innovation Fair in December 2024, where she exhibited the products and shared her innovation with the general public, policymakers, and institutional stakeholders.

9.0 Key lessons learnt during the PID process and recommendations

- The process fostered mutual learning among the innovator and her experimental group.
- The joint experimentation approach allowed the experimental group and stakeholders to learn about PID and the efficacy of compost in addressing soil fertility.
- The entire process that brought the women together in the PID process contributed to deepening unity and cohesion for collectively championing their own development processes.
- Farm and household waste can be utilized to produce cheap soil amendments to improve yields, thus saving funds used for chemical fertilizers and pesticides.

10.0 Plans to use this experience to scale up the PID approach and integrate it into agricultural research and development processes

- Prolinnova Ghana will support the innovator to share her innovation during the National Farmers Day celebration and Farmer Innovation Fairs at the Walewale learning site in 2025.
- The innovation will be shared and promoted by Agriculture Extension officers from the district

Department of Agriculture and CEAL through trainings, exchange visits, and farmer exhibitions.

- ACDEP will document the PID process and results in brochures, flyers, and a short video for engaging with ARD stakeholders to institutionalize the PID approach

11.0 Acknowledgements

The authors, including Dr. Mutari Abubakari (lead research facilitator) from CSIR-SARI, wish to acknowledge the roles played by all stakeholders in the PID process. These stakeholders include the innovator and her group, ACDEP, CEAL, Department of Agriculture (DoA), and other members of the local Multi-stakeholder platform who participated and supported the process to achieve the results. ACDEP/Prolinnova-Ghana conveys a special gratitude to Misereor in Germany for funding the PID activities through the ELI-FaNS project.

JOINT EXPERIMENTATION TO IMPROVE THE EFFICACY OF *PALIGA* (Securidaca longepedunculata) ROOTS FOR CONTROLLING PESTS IN STORED GRAINS BY SULEMANA OSMAN IN NORTH-EAST DISTRICT OF GHANA

By Mohammed T.Shaibu (CSIR-ARI), Isaiah Nasir (Presbyterian Agric Services), Joseph Nchor, and Denisia Abulbire (ACDEP); and Osman Ibrahim (Dept of Agriculture).

1.0 Name and general characteristics of the innovator

Mr. Sulemana Osman is a 45-year old small-scale farmer in the Chambuligu community of the North-East Gonja district of the Savanah region. He has a family of 9 members. He farms mainly maize (5 acres), cassava intercropped with yam (1.5 acres), groundnut (2 acres), and rice (2.5 acres). Farming is his major income source, but he also sells a few provisions in a small kiosk in front of his house for additional income. He has no formal education.

Sulemana Osman with the paliga leaves and root

2.0 Brief description of the innovation being further developed

Postharvest losses in the grains of farmers are a major challenge affecting food security in the community. Most farmers resort to using synthetic storage chemicals obtained from local shops. But these chemicals are expensive to afford while posing risks of poisoning the grains when processed into food. Sulemana Osman experimented by mixing *paliga* roots with stored maize, which proved effective in controlling the pests from infesting the grains. In his innovation:

– He digs the *paliga* plants for their roots and cleans the soil stains, peels off the bark with a knife, and then cuts the roots into pieces of about 3 cm long, using 8-12 pieces to preserve one bag of grain.

- The roots are first laid in the storage sack, and the grains are poured on it as the first layer.
- The roots are again laid on the grain, and another layer of the grain is added, this is done repeatedly until the storage sack is filled up.
- The strong scent from the *paliga* roots drives the storage pests away from the grain.
- Alternatively, after peeling off the bark from the roots, he dries and pounds this material into powder and mixes uniformly with the grains stored in sacks.

3.0 Why and how the innovation was identified and selected for PID:

The innovation of using the *paliga* roots to control pests in stored grains is of high importance because of its potential contribution to improving food security in farm households through reducing postharvest losses in storage. Insects' spoilage also reduces the quality of food produced from the grains, thereby affecting the healthy nutrition of households. The local NGO (PAS Mile 7), and members of the local Multistakeholder Platform, mainly from the Department of Agriculture and the Animal Research Institute, together with community members, therefore prioritized the innovation for improvement through the PID process of farmer-joint experimentation.

The specific reasons for selecting the innovation for PID were:

- It is an organic storage method and would solve post-harvest losses against the chemical storage method, which is expensive and contaminates the grain, rendering it unsafe for consumption
- The material is cheap and available in the community
- Potential for high adoption by many farmers when properly developed

4.0 Objectives of the PID and benefits to be derived

The main objective of the PID was to validate the efficacy of the *paliga* roots in controlling postharvest losses in maize grains. The challenge is that while the innovator has been using the *paliga* roots and their powdered form in controlling pests in stored grains, he does not know the right quantity of either the roots or powder that will be very effective against pests. The specific objectives were:

a. To determine the quantity of roots and their powder for effective control of storage pests in maize grains
b. To compare the efficacy of using the roots and powder for effective control of the pests

c. To improve the general knowledge of the innovator and community members on basic organic post-harvest management techniques.

The anticipated benefits from the PID were: (i) improvement in food security through reduced grain losses in storage since farmers will be able to feed their families over a longer period and with quality produce; (ii) increased knowledge and adoption of organic methods of storage for safer foods and, (iii) better incomes for farmers since they will able to store their produce for a longer period and sell at higher prices during the scarcity period.

5.0 The PID process

5.1 The main activities undertaken

Mohammed Tiyumtaba Shaibu, a research scientist from the Animal Research Institute (ARI) station in Nyankpala near Tamale, was the lead facilitator of the PID process. The co-facilitators were Isaiah Nasir of PAS Mile 7; Naomi Zaato, district director, and Osman Ibrahim, crops officer from North East Gonja Department of Agriculture; and Joseph Nchor and Denisia Abulbire from ACDEP. They formed part of the local Multistakeholder Platform. The experimentation, which took place in the Chambuligu community of the North East Gonja District and involved the innovator, his household members, and 15 other men and women as the experimental group.

The Innovator, the community group, and the facilitation team jointly planned and PID process, including setting up the experimental design and treatments, and agreed on the quantities of the *Paliga* roots and powder for the experiments based on 100 kilograms of maize each. ACDEP and PAS Mile staff coordinated logistical arrangements for implementation. The lead innovator provided the *paliga* materials, whilst each of the sixteen (16) experimental group members, including the lead innovator, provided 100 kilograms of maize grain. The following specific activities were implemented in the PID, which ran from February to July 2024.

- Sensitization and mobilization of the PID group and community,
- Training of the experimental group and community members on basic post-harvest management by the lead facilitator and DoA crops officer
- Gathering of inputs, materials, and tools by the lead innovator, PAS Mile 7, and ACDEP
- Development of protocols for the implementation of the PID
- Conduct of the PID process, including data collection by DoA, PAS Mile 7, and the lead facilitator

- Field documentation of processes, results, and analysis led by PAS Mile 7, ACDEP, lead facilitator
- Conduct of community participatory evaluation and sharing of the PID results by lead facilitator, PAS Mile 7, ACDEP, and DoA staff

5.2 Experimental design and procedure

Experimental Materials

The main experimental material in this study was the *paliga* roots and powder. Items and tools procured included a knife, mortar and pestle, wire mesh, weighing scale, sacks, containers, and tins. A metal chuck was used to draw maize samples during storage at three to five different portions of the bag. A data logger was used to record the monthly temperature and humidity of the storage environment.

Experimental Design

Originally, the innovator mostly used unprocessed roots to treat the produce by placing a bunch of 8-10 pieces of the roots (about 3cm each) in the stored grains.
Sixteen (16) farmers (including the innovator) participated in the experiment, eleven (69%) of whom were women.

a. The experiment was designed with 4 treatments and 2 replications for each factor, ie, roots and powder.

b. There were 2 replications of the control group in each of the factors where no *paliga* roots or their powder was applied.
c. For the *paliga* powder, the treatments for a 100kg bag of a grain (maize) were 100grams, 200grams, and 300grams.
d. For the *paliga* roots, the treatments were 300grams, 500grams, and 700grams, each applied to 100kg of maize. This is shown in Tables 1 and 2 below.
e. The same storage conditions applied to each experimental farmer's household, and treatments were applied to all grains in storage. The length of storage was from February – July 2024.

Picture of the experimental farmers

Paliga roots powder used for the experiments

Table 1: Treatments and Replications of Paliga Powder

Treatments	T1	T2	T3	T4
Powder	F1=0	F3=100	F5=200	F7=300
	F2=0	F4=200	F6=300	F8=100

NB: Figures are in grams; F is farmer

Table 2: Treatments and Replications of Paliga Roots

Treatments	T1	T2	T3	T4
Roots	F1=0	F3=300	F5=500	F7=700
	F2=0	F4=500	F6=700	F8=300

5.2 Data collection and analysis

A team of the lead facilitator, ACDEP, DoA, and PAS Mile 7 staff visited the community each month and collected data, made observations, and monitored the experiments by visiting each house of the experimental farmers. The visits often conclude with a meeting with all farmers to share observations and learnings among themselves and with the PID facilitation team. The following data were collected at the monthly visits.

Weights of stored grain

Each month, the weight of the stored grains was taken for a period of 6 months to take account of moisture lost during storage. Moisture levels were also determined pre- and post-storage. There were changes in the weight of a bag of grain due to loss of moisture content.

Temperature and humidity

Monthly temperature and humidity of the storage area were taken to determine if changes in temperature would have a direct correlation with changes in the weight of the stored grains. A data logger was used to record the temperature and humidity of the storage environment.

Insect population

A sample of grains (100 grains) was taken from each bag monthly during the storage duration. The number of insects was physically counted from each sample to determine the invasion rate. The average rate of invasion was then matched with the final weight, and the percentage of grains lost to post-harvest was determined. This was done for the control and treatment groups. It is important to note that each sample of grains taken each month for the experiment was not kept back to avoid taking the same or some of it for determination in the following or subsequent month(s).

Grain damages

In addition to counting the number of insects present in each bag as an expression of the level of infestation, damaged grains were also counted to determine the rate of spoilage. A sample of 100 maize grains was taken from each bag to determine the damage rate.

Lead facilitator recording monthly data on the treatments

Results from the experiments

At the end of the field experimentation, the facilitator analyzed the data collected and produced the preliminary findings and results, which were later shared at a community feedback session with the experimental group and community members. For the purpose of this PID process documentation report, the results/findings are summarized in brief below without including the detailed scientific analysis, discussion, and graphical presentations as were recorded and analyzed by the PID facilitator.

- Scientific information indicates that the best moisture content of maize ready for storage should not contain a moisture level above 15%. Higher moisture levels tend to accelerate the rate of spoilage of stored grains. From the PID data, except for one farmer during the first month, the moisture content of the maize of all the farmers was below 15% moisture content. This indicated the grains were properly dried before storage, and moisture conditions did not interfere with the *paliga* efficacy tests. In the subsequent months, the maize moisture content of the farmers was reducing, suggesting additional moisture loss during the six-month storage period.

- The findings revealed that farmers who applied 300 grams of *paliga* powder had an average of a lower number of insect invasions as compared to those who applied lower rates of 200 grams, 100 grams, and zero application. 300 grams of powdered roots, therefore, provided the best protection for maize.
- Within the root treatment regime, farmers who applied the highest rate of 700 grams had fewer grains damaged than those who applied 500 grams and 300 grams rates.
- With regard to the effect of treatment on the level of damaged grains, control treatments showed a higher number of damaged grains than any other treatments. Similarly, there were a higher number of insects in the root treatment (R-300 grams, R-500 grams, and R-700 grams) than in the powder treatment (P-100 grams, P-200 grams, and P-300 grams). These results further confirm the

effectiveness of using the powder as compared to the unprocessed root to control insects in stored grain.

- In summary:
  - *Paliga* roots powder, in general, was more effective in preserving grain than the roots. The specific quantity of the powder that proved most effective was 300grams, compared with lower rates
  - Grains stored with the powder had less insect population and fewer damaged grains compared with the raw roots application.
  - The quantity of roots that proved very effective in the roots treatment regime was 700 grams, as compared to the lower rates.
  - The PID experiment has proven that Sulemana's *paliga* innovation for preserving maize grains works more effectively with the powered roots than with the unprocessed roots.
  - The PID has helped to determine the recommended quantities of both roots and powder for optimum protection for stored grains against pests.

6.0 Participatory evaluation and sharing of the PID process and of its findings /results

Following completion of the field experimentation, a field day was held at the community in December 2024 to share the findings with the experimental farmers and other community members. The event enabled a participatory evaluation and learning from the results, process, and outcomes, whilst receiving feedback on the farmers' views, challenges, and recommendations. Forty-seven (47) participants of 14 men and 33 women, including the community chief and opinion leaders, participated in the participatory evaluation process.

The findings of the facilitator were confirmed by the experimental farmers. These include

- Farmers on the control treatment (no application of *Paliga*) had more insects in their grain compared to the other treatment groups.
- The powdered material proved more effective in preserving the grains than the roots, as there were fewer or no insects in their grains, because the powder spread more uniformly in the grain and offered more protection than with the roots
- Farmers who used higher quantities of the powder had fewer insects in their grains.

Feedback from innovators and community members:

- They expressed happiness about the PID process and results, which also improved their knowledge on joint experimentation.
- They expressed a high interest in adopting the use of *Paliga* powder for preventing post-harvest losses and will try it on beans and millet to see if it works. They will also try increasing the quantity of the powder in a bag of grain and increasing the

period of storage above 6 months to see the outcome.

– Community members felt more involved in the “Farmer-led” activities. They were more accepting of the concept and preferred it to solutions engineered and introduced by the technical people alone.
– The benefits were available to all genders, as women were also involved in the experiment, as 11 of the 16 experimenters were women, thus buttressing the keen interest of women in safe preservation of produce for household food security.

The lead innovator, Sulemana Osman, appreciated the project team for helping him to win an award and certificate from the Ministry of Food and Agriculture as the best farmer in the postharvest innovation category at the 2024 District–level National Farmers Day. The award has enhanced his social status in the district and community. He appealed for support to commercialize his innovation to benefit a wider population of farmers and households.

Sharing and participatory evaluation of the PID

7.0 Key challenges during the PID process

- Increasing difficulty in accessing the roots for the experiments. The tree population is threatened for its multifunctional importance, leading to overharvesting from the wild. The plan is to assist farmers to try propagating it in backyard gardens as the next PID process.
- Weighing of each bag at every visit was quite tedious, particularly for the women. Community volunteers provided labour support.
- Experimental farmers had to abandon or halt other activities (farm or house chores) to participate in the

experimental activities, including data collection, when the farming period set in

– Holding the bags of grains for 6 months for the experiment reduced food availability to less-endowed farmers' households. The project paid half of the total cost of a bag of maize in cash to cushion each farmer.

8.0 Sharing the experience and results/findings/outcomes of the PID process:

The innovator has shared his improved innovation on several occasions, including stakeholders' visits to his community, and at a community innovation exhibition for participants of the PID training for Prolinnova-Ghana partners, which took place in Tamale in August 2024 and was facilitated by Prolinnova IST members. He has also exhibited and shared it at the 2024 District level National Farmers Day celebration held in Kpalbe, the District capital, where he was awarded a certificate and farm inputs by the Ministry of Food and Agriculture for his outstanding innovation. He plans to exhibit and market the innovation at a farmer innovation fair to be organised by Prolinnova-Ghana and learning site partners in May 2025 to showcase innovations to relevant institutional stakeholders and policymakers.

9.0 Key lessons learnt from the PID process

- Innovator and his group, as well as other stakeholders, learnt about the effectiveness of *paliga* root powder and the roots in organically preserving grains.
- Joint experimentation and documenting the outcomes are key in validating and scaling an innovation
- The innovator felt recognized by 'outsiders' and his community members through the joint improvement process. This has enhanced his social status
- The entire process that brought the men and women together in the PID process has contributed to strengthening unity and cohesion towards collectively championing their own development processes.

9.0 Plans to use this experience to scale up the PID approach and integrate it into agricultural research and development processes

- The innovation will be promoted by Agriculture Extension Agents of the district Department of Agriculture through field extension and training of farmers for adoption or adaptation.
- Prolinnova-Ghana and learning site partners will assist the innovator to share his innovation at farmer

exhibition fairs and national farmers' days within the North-East Gonja District.

- Prolinnova Ghana will document the PID process and results in brochures, flyers, and a short video for engaging with ARD stakeholders towards institutionalizing the PID approach.

11.0 Acknowledgements

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WOMAN INNOVATOR JOIN HANDS WITH NUTRITION EXPERT TO IMPROVE THE NUTRITIVE VALUE OF HER *DOZIM CHISI* DAWADAWA CONDIMENT IN NORTH-EAST GONJA DISTRICT

By Naomi Zaato - Department of Agriculture; Joseph Nchor, Denisia Abulbire – ACDEP; Isaiah Nasir – Presbyterian Agricultural Station, Tamale.

1.0 Name and general characteristics of the innovator

Madam Kasim Asimawu is 52 years old and married with three (3) children. She comes from the Kpanshegu community in the North-East Gonja District of Ghana and has no formal education. She is a small-scale farmer, cultivating groundnuts, soybeans, and rice in small acreages to feed her family while selling parts of the produce to meet other basic needs. She produces and sells charcoal as an additional source of income for her family.

Innovator Madam Asimawu Kasim

2.0 Brief description of the innovation being further developed

Dawadawa is a traditional condiment made from the seeds of the African locust bean tree (*Parkia biglobosa)*, commonly called dawadawa tree. The seeds are cooked and fermented to make the *dawadawa*, which is used as a major ingredient in preparing foods and soups, particularly in the northern parts of Ghana. In its preparation, some women would add roasted groundnut powder to nutritionally fortify the condiment. Extraction of the seeds from the pods leaves a yellow powder, which is also consumed as food. The residues (in grits form) known in the local language as *dozim chisi* are a by-product from the powder extraction process and are mostly fed to domestic livestock and poultry. However, through self-experimentation and innovation, Madam Asimawu decided to add the *dozim chisi* materials to the processing of her *dawadawa*, making it tastier, yellowish, and very much liked by many women in her community. Adding the by-product during processing also increases the quantity of the condiment to last for a longer period of use. The following steps describe her innovation.

a) She boils 6kgs of dawadawa seeds for about 8-9 hours, after which she adds a handful of *Tuo-zaafi* (TZ) – solid food made of maize or millet, and allows overnight, and the TZ is removed and disposed. Culturally, it is believed that adding TZ will prevent the dawadawa from going out "to beg" for it and would result in a reduction of the quantity of dawadawa material to be processed.
b) She adds fine dry ash to the boiled seeds to aid the removal of the seed coats/shells during pounding. She then washes the pounded material to obtain a fine grade of the dawadawa seeds, which she boils again for about 2-3 hours, cools, and sieves with water.

c) She puts the seed in a pan and wraps it completely with plastic wrap in a room for 3 days, becoming softer and fermented due to the heat generated.
d) After the 3 days of fermentation, the seeds are dried in the sun for another day before being pounded and molded and ready for use as the ordinary condiment.
e) She weighs 700 grams of the finished condiment into a mortar and adds 90 grams of dawadawa powder by-product – *dozim chisi,* and pounds together, obtaining a good mixture which she molds into balls of 100 grams as the improved product.
f) Finally, she dries the *dozim chisi*-improved dawadawa condiment balls in the sun for seven (7) days to preserve them from spoilage, following which she uses them in preparing various dishes
g) By adding the *dozim-chisi* by-product to the condiment, the innovator increases the nutritional value, taste, and quantity of her dawadawa, creating a nutritionally-improved condiment for household nutritional enhancement.

3.0 Why and how the innovation was identified and selected for PID

The innovation was selected for PID because Dawadawa condiment is used in every household for preparing a variety of dishes in many rural and urban households, particularly in northern Ghana, and contributes significantly to healthy nutrition and reduction in malnutrition in children and adults. It has 40 percent protein and other probiotic properties, which make it a better and cheaper local substitute to the industrial *Maggi* cubes sold in shops. The innovation has the potential to improve household food and nutrition security because it combines ingredients from different food items that are largely found within the community.

Based on these important attributes, the innovation was jointly selected among the other 15 profiled innovations from the learning site for further joint improvement at a community validation meeting. The participatory selection involved farmers, opinion leaders, innovators, and women group members, as well as the local MSP members drawn from the Department of Agriculture, Presbyterian Agriculture Station NGO (PAS mile 7), and the Animal Research Institute (ARI). The prioritization of the innovation for PID was based on a guideline that was jointly developed and approved by the community members and the other stakeholders within the context of the project objectives to improve food security and healthy nutrition of households sustainably.

4.0 Objectives of the PID and benefits to be derived

Usually, groundnut is used by women to fortify dawadawa condiment, but the high cost of groundnuts due to declining yields makes it less affordable. The innovator explored through self-experimentation and discovered that adding *dozim chisi* to the normal dawadawa condiment preparation improves its taste and also increases the quantity of condiment processed. However, production of dawadawa fruits from which *dozim chisi* is obtained is seasonal, and the material often runs for over 8 months in the calendar year. Hence, the innovator saw a need to engage in joint experimentation with nutritionists to find alternative substitutes for both the *dozim chisi* and groundnut material so as to continuously fortify and sustain the supply and access to nutritionally-enriched dawadawa for households.

The specific objectives of the PID were therefore:

- To experiment with soya beans and yellow maize flour ingredients as substitutes for fortifying dawadawa condiment, and alternative ingredients to groundnut and dozim-chisi residues.
- To determine the right proportions of mixing dawadawa with dozim chisi, dawadawa with soybean flour, and dawadawa with yellow maize for improving its nutritional value and diversifying the condiment.

The ultimate benefits from the PID process would be a more enriched dawadawa condiment to improve nutrition and reduce malnutrition in households.

5.0 The PID process

5.1 The main activities undertaken

- Ms. Naomi Zaato, a nutrition expert from the Department of Agriculture, North East Gonja Department of Agric in the Savanna region of Ghana, facilitated the PID process. She was assisted by the MSP members, two extension staff from the North East Gonja Department of Agric, staff of the local NGO – PAS Mile 7, and ACDEP project officers (Denisia and Amama).
- The PID process involved Madam Asimawu and her group, husband, and other family members, other innovators in the community, some men and women, and opinion leaders in the Kpanshegu community. The stakeholder staff also observed and learned in the experimentation processes.
- The PID process conducted from February to June 2024 involved joint planning and design of the experiment, acquisition of inputs, monitoring and recording, participatory evaluation, and documenting the process and results. The nutrition expert developed protocols that were jointly validated with the innovator and community members.

- Inputs and materials identified during the planning process were partly provided by the innovator and through the Local Innovation Support Facility (LISF) under the project. For instance, the innovator and her group members supplied the yellow maize, soybean, and *dozim chisi* residue, water, fuel wood, and cooking utensils. The project provided some processing containers, a weighing scale, and additional food materials and ingredients.
- The PID started with the lead facilitator providing training to the innovator and her group on basic nutrition, including theoretical and practical food fortification demonstration at the community level. The training practically demonstrated how to process the various grains and cereals into flours without reducing their nutritional value, measurement of ingredients for fortification, hygienic food preparation, and various fortified food recipes. The other institutional stakeholders/ and MSP members participated to learn. During this training, the innovator and her group were able to prepare different fortified dawadawa condiments and their recipes.

5.2 Research/experimental procedure

For improving the taste and nutrition of *dozim chisi* dawadawa and diversifying it, the following substitutes and combinations of dawadawa condiment recipes were prepared (the measurements were guided by scientific micronutrient information of the ingredients).

- Soybean dawadawa condiment: Dawadawa seed (3parts) + soybean (1part)
- Dozim chisi dawadawa condiment (innovator's recipe): Dawadawa seed (7parts)+dozim chisi (1part)
- Groundnut dawadawa condiment: Dawadawa (3parts)+dozim chisi (1/2 part) + groundnut (1/2 part)
- Yellow maize dawadawa condiment: Dawadawa (3parts) + yellow maize (1part)

Dawadawa condiments from the PID process
(Photo: Denisia Abulbire, ACDEP)

The innovator and her groups divided themselves into 4 groups and each group assigned to one recipe above. After processing, they sun-dried their products and used each to prepare different soups recipes and eaten with *Tuo Zaafi* food during the subsequent sensory evaluation

Innovation group and the nutritionist with ingredients for dawadawa condiments

6.0 Evaluation of the PID process and of its findings/results/outcomes

The four different dawadawa condiments prepared above by the innovator and the three women groups were used to prepare different local soup recipes to eat with *Tuo zaafi* in order to evaluate the nutritional quality (taste, aroma, colour, and overall preference) of each soup and give feedback. Four categories of people, namely women, men, opinion leaders, and school children aged 7 years and above, took part in the eating and sensory evaluation exercise. Members of each evaluation group used a scale of 1-3 (1=***poor*** and 3= ***best***) to rate each of the soups.

The men and opinion leaders evaluated all the dishes prepared with the different condiments to be nutritious, tasty, and healthy. They concluded that food cooked with dawadawa and without industrial Maggie is better than food cooked with Maggie, and hence promised to support the innovator and her group to adopt the various dawadawa condiments for their daily meals

The school children could only evaluate the taste of the recipes but could not rank any recipe higher than the other because all the foods prepared with any of the condiments were nutritious, healthy, and tasty. They were of the view that their mothers should adopt the different condiments developed from PID in preparing dishes for their families.

The women ranked dishes with the innovator's condiment as highest for the taste, aroma, and yellow colour. Her condiment is composed of 7 parts of dawadawa seed and 1 part of *dozim chisi* residue.

Tasting of the different dishes of dawadawa recipes by women and children of Kpanshegu

The different soups prepared with the four dawadawa condiments for the sensory evaluation (Photos: Denisia Abulbire)

Community feedback on the PID process

- The innovator, her group, and the people of Kpanshegu community participated actively throughout the PID process. They were grateful that the PID process had equipped them with knowledge for increasing the nutritional value of their foods.
- They also gained knowledge about basic food nutrition, food processing, and fortification so as to improve their household food and nutrition security. They are very enthusiastic about adopting the recipes for their everyday meals.
- The PID was seen as timely because in the year 2024, the dawadawa fruit and groundnut yields were low due to a long dry spell, rendering their prices high to afford. Therefore, experimenting

with soya beans and maize flour as substitutes gave them variety to choose from to continue processing nutritious dawadawa condiments for their daily meals.

- Moving forward, the innovator and group members intend to join hands with experts to explore possibilities of storing the *dozim chisi* over a longer period without spoilage. This will enable them to take advantage of bumper fruit yields in some years to process and stock large quantities of the material safely for year-round use.

7.0 Challenges encountered during the PID process

The major challenge encountered was the delayed time. The PID had to be kept on hold until was dawadawa fruiting season to access the main materials (dawadawa seeds and flour residues) for the process. The process subsequently coincided with the onset of rains for the major farming activities, thus posing an extra burden on the women in participating in the PID process alongside their farming activities.

8.0 Sharing of the experience and results/findings/outcomes of the PID process:

The different dawadawa condiments and their recipes were shared with the Kpanshegu community members, opinion leaders, the youth, and the school children. The innovator also shared her innovation and the PID results with women in two neighboring communities, namely Chambuligu and Takpuli, in the North East Gonja learning site. She further shared her improved innovation with participants of the PID training for Prolinnova-Ghana partners, which took place in Tamale in August 2024 and was facilitated by Prolinnova International Support Team (IST) members. She is planning to participate and share the innovation at a local innovation fair being planned for 2025, which will enable innovators to showcase their innovations to relevant institutional stakeholders and policymakers

9.0 Key lessons learnt during the PID process

- Innovator was glad to undertake the joint process with a nutrition expert to further develop her innovation with a combination of other locally available ingredients – soya, maize, and groundnuts to improve the nutritional value and diversified recipes. The innovator and her group have learnt the right quantity of *dozim chisi* for making a nutritionally richer dawadawa condiment. The community felt appreciative of the opportunities brought forth that would enhance the nutritional well-being of families.

- The process generated cross-learning among the innovator and her peers in the community, as well as bottom-up learning by the PID facilitator, MSP members, and institutional stakeholders who participated.
- The innovator felt recognized by 'outsiders' and within her own community through the joint improvement and promotion of her innovation. This has empowered her socially and economically.
- The entire process that brought the women together in the PID process has contributed to strengthening unity and cohesion towards collectively championing their own development processes.

10.0 Plans to use this experience to scale up the PID approach and integrate it into agricultural research and development processes

- The innovation will be shared and used by the Women in Agriculture Development officer (WIAD) and other Agriculture Extension Agents of the district Department of Agriculture to train women in other communities to adopt good nutritional practices.
- The innovator will be assisted to share her innovation at farmer exhibition fairs and national

farmers' days within the North-East Gonja District.

- ACDEP has documented the PID process and results in brochures, a flyer, and a short video to support dissemination and to engage with ARD stakeholders towards institutionalizing the PID approach

11.0 Acknowledgements

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