Future of Bio-fertilizers in Ethiopian agriculture

Bio-fertilizers are natural fertilizers which constitute living soil microorganisms such as microbial inoculants of bacteria, algae, and fungi. They improve the soil fertility and crop production through supply of easily utilizable form of nutrients to the host plants when they are applied to seed and/or soil.

Bio-fertilizers are grouped into different types based on their functions such as nitrogen-fixing, phosphate-solubilizing, and phosphate mobilizing.

The role of bio-fertilizers in agriculture assumes special significance, particularly in the present context of increased cost of chemical fertilizer and their hazardous effects on soil health.

Integrated Soil Fertility Management (ISFM)

The 15 months Promoting Soil Fertility Technologies through capacity building of Farmer Training Centers in PASIDP target regions project aimed to enhance dissemination and uptake of soil fertility technologies in Ethiopia's Amhara, Oromia, SNNP and Tgiray regions.

Funded by IFAD and AGRA, Self Help Africa (SHA), worked with 40 farmer training ceneters (FTCs), 80 development agents and 200 lead farmers to enhance the knowledge of ISFM and reach more than 20,000 farming households. This booklet is one of a series of four focusing on each of the project's key components of the ISFM intevention:

1. Blended fertilizers,
2. Bio-fertilizers,
3. Lime application, and
4. Conservation Agriculture

MINISTRY OF AGRICULTURE
IFAD Investing in rural people
AGRA Growing Africa's Agriculture
Self Help Africa

BACKGROUND

Soil is the basis for crop production as it supplies essential nutrients to crops. However, soil fertility is declining in Ethiopia mainly due to poor soil management practices, which in return affects crop productivity. Of all the essential nutrients, nitrogen (N) is required in large amount by crops. It is a key component in chlorophyll and plant proteins. Although, nitrogen is the most abundant element in Earth's atmosphere (constituting 78% of the air), it is the nutrient that mostly deficient in soils and most frequently the limiting factor in crop productivity (ref). Plants cannot uptake nitrogen as a form it exists in the atmosphere. Hence, atmospheric nitrogen must be transformed into reactive and or reduced forms/ converted to a usable form/ so that plants can use it. Biological nitrogen fixation by micro-organisms is one of the ways that atmospheric nitrogen can get fixed into usable forms to the plants. Nitrogen fixing micro-organisms perform about 90% of the natural nitrogen fixation and are therefore an important component of sustainable agricultural development. There are two types of nitrogen-fixing microorganisms: free-living (outside the plant cell) and symbiotic (living symbiotically inside the plants).

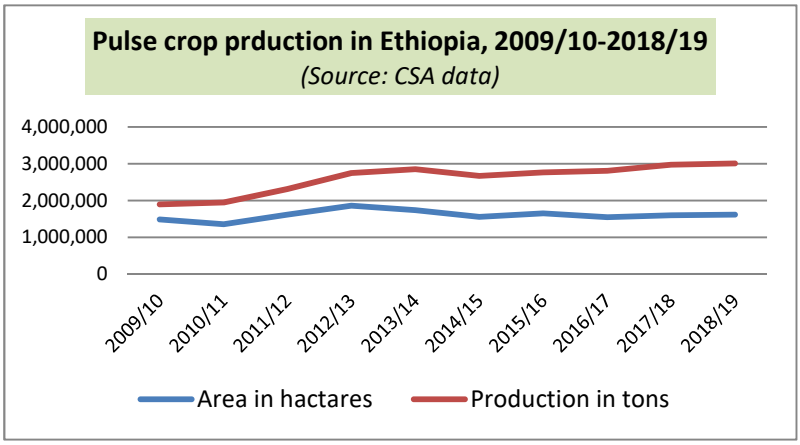
Pulse crops develops symbiotic relations with soil microbes/symbiotic bacteria such as soil Rhizobium bacteria (rhizobia), within the nodules on their root system that can convert the atmospheric nitrogen into a form the plant is able to use for their growth. In return, the plants also provide the nutrients required by the rhizobia. In this ways, pulse legumes fix atmospheric nitrogen into the soil. The residues and exudates from the pulse crops add to the nitrogen of the soil to be used by other subsequent non-leguminous crops, such as cereals. Hence, the inclusion of pulses in multiple cropping systems such as intercropping or in simple crop rotations is indeed considered important for the integrated management of the soil nutrients and for moving towards conservation and organic agriculture. Besides, their importance for maintaining soil fertility, pulse crops is a good source of protein, and generates a good income for the farmers. Therefore, incorporation of pulses in cropping/farming systems is important to promote integrated soil fertility management (ISFM) to enhancing soil and human health. Pulses must be well nodulated for maximum atmospheric nitrogen fixation and rotational benefits. Yet, when there will be no adequate amounts of effective rhizobia in the soil, there is a need to inoculate the pulse crops seed with appropriate strain of rhizobia during planting time to ensure good levels of nodulation. So, it is recommended to inoculated pulse crops at planting.

This report provides some highlights on use of bio- fertilizer in increasing pulse crops productivity the country.

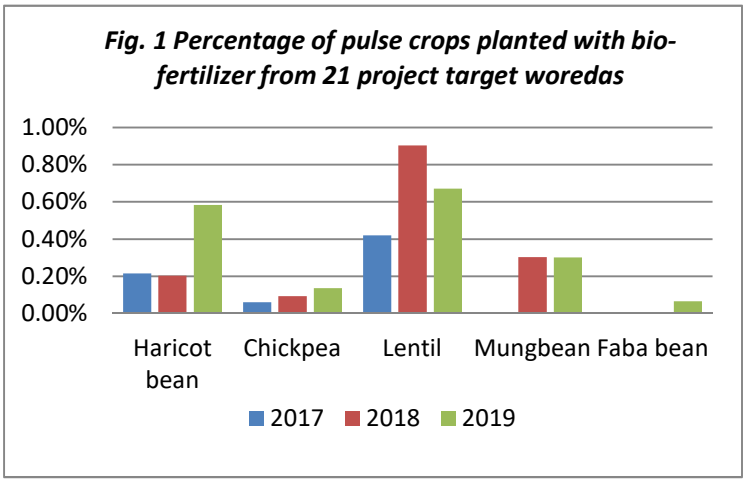
Pulse crops production and Bio-fertilizers in Ethiopia

Pulses are important crops in Ethiopian agriculture as they contributing to enhance smallholder farmers' food and nutrition security as well as their income. Faba beans, field peas, haricot

beans, grass peas, soya beans and mung beans make up the majority of pulse crops grown in Ethiopia. Out of the total grain crop area in 2018/19 production year, 12.73% (1,620,497.30 hectares) was covered under pulses (CSA, 2019). They are grown mostly as crop rotation and/or in marginal lands. Moreover, no fertilizer is applied in legume crop production and application of inoculated pulse seed is also a recent phenomena in the country. Consequently, there is low productivity of grain legumes, about 1.9 metric tons per hectare and 9.54% (about 3.01 million tons) of the grain production was drawn from the pulse crops (CSA, 2019). Yet, it shows an increasing trend, for instance between 2009/10 and 2018/19, pulse crops area, production and yield have increased by 9%, 59% and 46%; respectively. This indicates more option is given to increase pulse productivity than expanding/allocating more lands. In this regard, application of bio-fertilizers (inoculants) on pulse crops would play a significant role.



However, according to the second Growth and Transformation Plan (GTP II) document, there was a plan to increase the average productivity of pulse crops by 53% from 1.7 tons/ha in 2015 to reach 2.6 tons/ha which will increase the total volume of produce from 2.6 million tons in 2015 to 3.88 million tons by the year 2020. In addition, there was a target to increase area of pulse crops cultivated by bio-fertilizers from 11,963 hectares in 2015 to about 260,000 hectares by 2020. This means about 16% of the total area planted with pulse crops of the 2018/19 production year. This is really much lower considering the importance of pulse crops, area planted and urgency to increase its productivity. Besides, by end of the GTP II period, the Ministry of Agriculture intended to increase the number of microbial species from 2 in 2015 to 17 by 2020. Yet, in the quick assessment of from the 21 project target woredas revealed that the amount of inculated pulse crop areas are much lower than and there is a much efforts remained even to meet the planed areas.



Project Activities

The project helped to promote the use of bio-fertilizer in pulse crops through the different capacity building activities through 40 farmer training centers (FTCs) in 30 districts drawn from 4 regions of Ethiopia in implementing several interrelated project activities.

Project activities included:

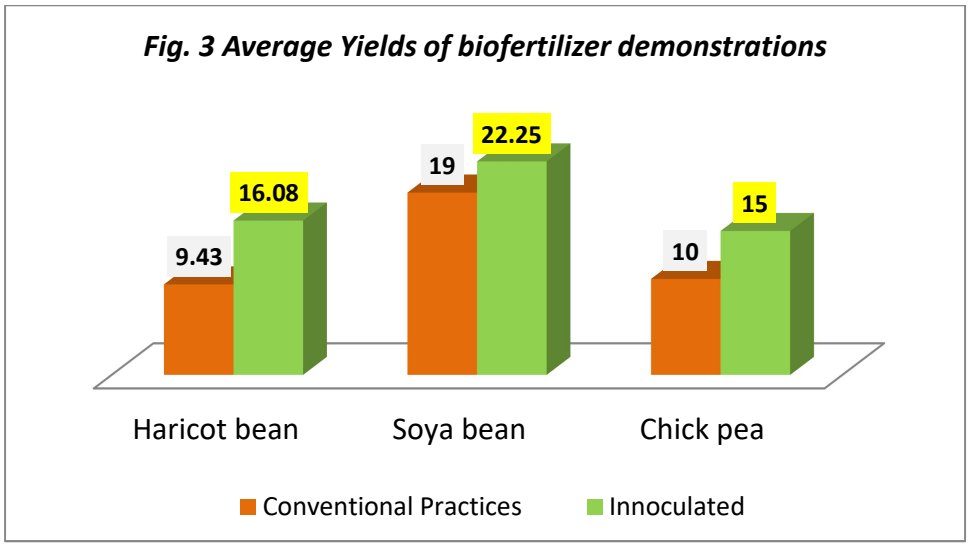
- Conduct a rapid assessment of current agricultural technologies and practices of farmers in the project areas
- Prepared bio-fertilizer training manual
- Develop different communication materials such as posters, brochures, and banners)in three local languages
- Train Development Agents and Lead Farmers on bio-fertilizers
- Print and distribute EthioSIS soil map copies
- Provide training on on EthioSIS soil mapping and atlas interpretation and fertilizer recommendations
- Establish demonstration plots
- Conduct farmers field days
- Deployment of soil texture kits and NPK Soil kits
- Train DAs on soil testing equipment handling and analysis techniques
- Distribute small packs of bio-fertilizer fertilizer
- Provide training
- Establish agro-dealer groups and provide technical and business management trainings; as well as link them with agricultural input providers

Results

There are 93 on-farm demonstrations conducted both at FTCs and farmers field to demonstrate the bio-fertilizers response on different pulse crops (faba bean, haricot bean, chick pea, mung bean, and soybean) planted by the farmers along with the farmers conventional practices (no fertilizers applied on pulse crops). On the basis of the available data gathered from the farmers, the corresponding yield advantage per plot over the conventional practices due to the use of bio-fertilizer for soya bean, chickpea, and haricot bean crop varieties is 17%, 50% and 71%; respectively. It could be considered an excellent performance if the yield obtained from this plot of land was converted in to hectare.

Fig. 2 Asagirt woreda – biofertilizer demonstration on faba bean

Inoculated faba bean field Conventional farmers practice



Source: Sample demo site survey, 2020

Before engagement of the project it is observed that there were limited bio-fertilizer promotion activities conducted by different organizations; mainly agricultural research centers and university researchers. Now at least a significant awareness is created by the project where large number of farmers has shown interest to grow their pulse crops with application of bio fertilizers. Yet, in most cases farmers expressed their fear on where do they will get the bio-fertilizers. The project has organized a learning discussion between project participant famers and district and zonal office of agriculture representatives where some of the project woreda office of agriculture staff promised to facilitate the linkage and bring the required inputs if the farmers are ready and decide to use bio-fertilizers. In this regard, the project has also promoted a brochure of private supplier to get contacted by the farmers as well as agro-dealers in the project areas. On other hand in Tigray region, the office of agriculture staff stated that there is no problem of the supply as their region has also produced the bio-fertilizer and will follow up the created demand to provide the supply.

Next steps

Nowadays, smallholder farmers' interest for bio fertilizers is increasing in areas where the demand is created. This should be further strengthening with creating more demands and supporting in availing the bio fertilizer inputs. This would be an alternative to chemical fertilizer and valuable to the farmers and the overall economy as bio fertilizers are less expensive and are more environmentally-friendly than chemical fertilizers. In general, there is a promising future for bio fertilizer in Ethiopian future agriculture. Hence, a considerable attention should be given to increase use of bio fertilizers as it has the potential for sustainable agriculture in Ethiopia. Moreover, development to multifunctional bio-fertilizers should also be considered as currently properties and a single function microorganism (bio-fertilizers) is available.