Traditional Practices Of Ginger Cultivation In Odisha: A Critical Intervention For Sustaining Farm Productivity

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Abstract
Ginger (Zingiber officinale Rosc.) is an important cash crop cultivated by tribal farmers of Odisha for livelihood. Despite the conducive agro-climatic condition, the productivity of ginger in Odisha is below (1.90 t/ha) as compared to national average (5.0 t/ha). Therefore, the present study was carried out during 2011-12 and 2012-13 to assess the current status of the traditional practices of ginger cultivation followed by farmers. For this purpose, four districts of Odisha namely Nayagarh, Ganjam, Kandhamal and Keonjhar were selected where ginger is grown by the majority of farmers. The sample consisted of 360 farmers including 180 women. It has been noticed that a large number of tribal farmers still practice the traditional methods of ginger cultivation. Ginger is grown in homestead, or as an intercrop, or sole crop by farmers. Kurupampadai, Wynad types, Local types viz., Kuduli, Laxipur, Turia Janagarth, Raikia, Suprapha and Surchi cultivars are grown by farmers. Overall, the package of technologies i.e. rhizome treatment, soil application of Trichoderma, wood ash, crop rotation, mulching, plant protection measures resulted in average yield increase of 15-20%. While the traditional method crop yielded an average 5-6 t/ha, by adopting this package of technologies farmers with reduced input use could harvest 7-8 t/ha. The demonstration plots had higher number of productive tillers per m² and rhizomes per plant. The higher yield obtained and the reduced cost of cultivation led to an overall higher net profit of minimum Rs.80500 per ha. The adopted farmers were happy and many of them acted as master farmers to spread these technologies to progressive farmers of the adjoining villages.

Keywords: Ginger, traditional practices, productivity, rhizomes, Odisha

Introduction
Ginger (Zingiber officinale Rosc.) is a perennial herb and being cultivated in India for both as fresh vegetable and as a dried spice, since time immemorial. Ginger has a share of 9% in the total production of spices. The crop originated as a native of tropical South-East Asia and was introduced into the West Indies, African countries and other tropical countries of the world. It is sold as fresh ginger or, more frequently, in a peeled and split dried form. Ginger is widely used in pickles, candies and such other preparations and as a medicinal herb. Dry ginger is used for preparing ginger powder, extracting ginger oil, oleoresin etc.

The major ginger producing countries are India, China, Nigeria, Indonesia, Bangladesh, Thailand, Philippine, Jamaica, United Kingdom, United States and Saudi Arabia import large quantities of ginger. Nigeria ranks first with respect to area under ginger covering about 56.23 percent of total world area followed by India (23.60%), China (4.47%), Indonesia (3.37%) and Bangladesh (2.32%). China ranks first with respect to ginger production contributing about 24 percent of world’s production followed by India (23.56%), Nepal (12.52%), Thailand (10.26%) and Nigeria (9.63%). Ginger production in India during 2012-13 was at 7.45 lakh tons from an area of around 1.58 lakh ha<sup>1</sup>. Indian ginger is produced in the states of Assam (123.9 thousand tons), Kerala (56.2 thousand tons), Gujarat (39.1 thousand tons), Mizoram (38.0 thousand tons), Sikkim (35.6 thousand tons), Odisha (30.6 thousand tons), Arunachal Pradesh (33.3 thousand tons) and Meghalaya (21.5 thousand tons). High global demand for Indian ginger is due to its lemony flavor. India has capabilities to meet the quality and quantity demands of importing countries matching to international standards<sup>2</sup>-<sup>3</sup>. India earned a foreign exchange of around Rs 26626.77 lakh during 2011-12 through ginger export of 35616.35 tons<sup>4</sup>. The crop exhibited an annual growth rate of 4.6 per cent in area, 7.4 per cent in production and 2.7 percent in productivity<sup>5</sup>.

Odisha is suitable environmentally and has the highest area under ginger cultivation in tribal belt of Khandhamal, Koraput and Keonjhar. However, the productivity (1.90/ha) is much below as compared to other states. This is because the crop is mainly grown by tribal farmers for their livelihood which followed traditional practices<sup>6</sup>. Odisha produced ginger 33370 t from 16530 ha. In Odisha, Khandhamal ranks first in ginger area as well as production (9340 t from 4290 ha) followed by Koraput (5900 t from 2710 ha) and Keonjhar (2270 t from 1110 ha). In fact, the awareness on innovative practices for commercial cultivation of ginger in the state is less. Ginger has been a key spice in the state contributing substantially to the income and employment opportunities of the tribals. Moreover, di-
verse agro-climatic conditions coupled with abundance of natural resources provide good opportunities for ginger production in this state. Information on traditional practices of ginger cultivation in Odisha is not well documented so far. Therefore, an effort was made to assess the current scenario of the traditional practices followed by farmers for cultivation of ginger in Odisha along with technological interventions like rhizome treatment, soil application of Trichoderma (biocontrol agent), wood ash, crop rotation, mulching, plant protection measures so that Indigenous Technical Knowledge (ITKs) along with validated and recommended technology for adoption of ginger cultivation can be documented and popularized among ginger growers for enhancing productivity with quality.

Methodology
The study was undertaken in four districts of Odisha such as Nayagarh, Ganjam, Kandhamal and Keonjhar during 2011-12 and 2012-13. From each district, 3 villages were selected where this crop is being cultivated commercially. Skill trainings and exposure field visits were organized for skill up gradation of farmers in cultivation of ginger. After preliminary survey, thirty randomly selected farmers from each village were organized into ginger growing groups (with adopted technology like seed treatment, soil application of biocontrol agent like Trichoderma, wood ash, crop rotation, mulching, plant protection measures). Similarly, another thirty random farmers from each village were selected as control group or Non-adopted technology group and they were allowed to follow their own practices. Finally in the year 2012-13, the impact of technological interventions was studied to visualize the differences between the two practices. The samples consisted of 90 farmers from each district and in total 360 farmers were selected. The information on the method of cultivation, varieties, seed selection, seed treatment and method of planting, mulching, crop rotation, plant protection practices, harvesting and post harvesting activities were collected time to time by monitoring, personal interview and discussion with adopted technology groups and Non-adopted technology groups.

Results And Discussion
Land Use Pattern
The hill forest is used as agricultural fields by the tribal people for ginger cultivation. Farmers of Kandhamal and Koraput preferred upland and backyard for ginger production. They practice slash and burn method of agriculture also called shifting cultivation or locally poda. Generally tribal people hold the land for shifting cultivation for 2–3 years and wait for 5-6 years for regeneration of forest cover. From February the process of cultivation is begun by cutting trees and bushes and burning them. The ashes fertilize the lands as the summer monsoon sets in, farmers prepare the land by ploughing and stirring with hand hoes. In the jhum area, ginger is cultivated without much land preparation i.e. farmers just dig the soil to make a hole and plant the rhizome in it. Before planting ginger, weeds and bush re-growth are slashed manually and left on the soil as a mulch. The land is then hand hoed superficially. In the lower hills of Kandhamal and Koraput districts, farmers make drainage channels around the field. After covering the soil plant materials are burnt. Though it is not burn totally it helps in soil sterilization. A particular hill slope or the area that is to be cultivated in a particular year is chosen during a common village meeting. Work is distributed among family members according to the ability of the individual members. The adult males between 18-50 years of age undertake the strenuous work of ploughing and hoeing, whereas cutting of bushes and shrubs, cleaning of seeds for sowing and weeding is done by women. All activities are accompanied by ritual performances.

Nutrient Management
It has been observed that farmers of the Kandhamal and Keonjhar districts are not applied any fertilizer in ginger crop however, cattle manure and goat manure @ 2-3 t/ha are applied by the tribal farmers in their backyard cultivation. Few farmers also applied neem cake 1-2 t/ha. They believed that application of neem cake as basal dose helps reduce the incidence of soft rot of ginger and increases the yield.

Seed Materials and Planting Method
Before planting stored rhizomes are sorted, rhizomes that is large, shiny, free from spot and diseases or marks or bud injury are selected for planting. Progressive farmers dip rhizomes in hot water for 10 minutes to eradicate seed borne diseases. In Odisha planting of ginger is done in the month of April after receipt of pre-monsoon showers. Ginger is universally propagated from cutting of Rhizome known as bits. A direct relationship has been observed between size of planting material and yield. Farmers are used bits 3-5 cm in the length weighing 20-25g in small pits at a spacing of 20 x 20 cm to 25 x 25 cm and at a depth of 4-5 cm with at least one viable healthy bud facing upwards. A seed rate of 15-20 q/ha is used for planting. Before planting, some farmers are treated bits with fungicide like carbendazim and mancozeb @ 3g/litre of water for 30 minutes and shade dried 3-5 hours as a safeguard against soft rot and to induce early sprouting. Farmers are planted ginger at the spacing of 25-45 cm between rows and 15-20 cm between plants. Farmers of Odisha believed that high density planting would increase rhizome yield hence, they kept 3-4 rows in a bed of 60 cm size. Before planting seed rhizomes are broken into pieces to ensure each piece has 2-3 viable and sprout buds. For backyard cultivation and for home consumption mother rhizomes are
used for planting but for medium and large cultivation split rhizomes are used for planting. It has been noticed that at the time of planting farmers applied 25 g powdered neem cake and mix well with the soil in each pit. Farmers said that application of neem cake control the termite and other insects and increase yield. Seed rhizomes are placed in shallow pits and mixed with well rotten cattle manure or goat manure @ 2-3 /ha.

Varieties
Kuruppampadi, Wynad types, Local type’s viz., Kuduli, Laxipur, Turia Junaghar, Raikia, Suprabha and Suruchi cultivars grown in Odisha. Besides of these some high yielding varieties of ginger developed by Orissa Agriculture University of Technology, Bhubaneswar is cultivated by the farmers. The salient features of high yielding varieties of ginger are described here.

**Suprabha:** Plumpy rhizome, skin is bright glazy, less fibre, wide adaptability, suitable for both early and late sowing, duration 229 days. 8.9 % oleoresin, 4.4% crude fibre, 1.9% essential oil and 20.5% dry recovery, tolerance to rhizome rot and average yield ( fresh rhizomes) was 16.7 t/ha.

**Suruchi:** Profuse tillering, bold rhizome, skin is bright glazy, suitable for irrigated/ irrigated conditions, duration 218 days, 10.9% oleoresin. 2.0% essential oil, 3.8% crude fibre, 23.5% dry recovery, tolerance to rhizome rot. Yield ( fresh) at farmers field was recorded 11.6 t/ha.

**Surabhi:** Plumpy rhizome, dark skinned yellow fleshed, suitable for both irrigated/ rainfed, duration 225 days. 10.2% oleoresin, 2.1% essential oil, 4.0 % crude fibre. 23.6% dry recovery, tolerance to rhizome rot. Average yield (fresh) at farmers field was recorded 7.5 t/ha.

Mulching
Mulching the ginger beds with green leaves is an essential operation to enhance germination of seed rhizomes and to prevent washing off soil due to heavy rain. Farmers believed that mulching with leaves, twigs and tender stems of locally available plants also helps in increasing infiltration, organic matter to the soil and conserve moisture during the later part of the cropping season. The first mulching of Sal leaves is done @ 10 - 12 t/ha at the time of planting. It is repeated @ 5 t/ha at 40th and 90th day after planting. Farmers are also cultivating green manure crops like daincha and sunn hemp in the interspaces of beds, along with ginger and harvested the green manure crop during second mulching of ginger beds. Farmers are applied *Lantana camara* and *Vitex negundo* as mulch to control the infestation of shoot borers. Cow dung slurry and liquid manure poured on the bed after each mulching to enhance microbial activity and nutrient availability. For the management of soil fertility, the farmers incorporated biomass of leguminous crops like pigeon pea, black gram, cowpea, cluster bean and French bean. Besides improving soil fertility, these crops utilize at home consumption and income-generating of tribal families. Some farmers are applied wood ash @ 50- 80 kg / ha in the field as this increase the potash. Tribal farmers of Kandhamal are applied well-decomposed cow dung @ 5–6 t/ha as a basal dose while planting the rhizomes in the pits. Progressive farmers are also applied neem cake @ 2 t/ ha to reduce termite damage.

Crop Rotation
Under irrigated conditions, ginger is rotated with plantation, turmeric, onion, garlic, chillies, maize and groundnut. Under rain-fed conditions, it is grown once in 3 or 4 years in rotation with tapioca, sweet-potato, yam, chilli. Apart from ginger farmers grown pulses, cereals, oilseeds in hills top and maize, vegetables are grown in kitchen garden and this practice is growing of mixed crop is dedicated by their food habits and ecological conditions. Ginger is also grown with maize as a mixed crop and as an intercrop in guava, coconut and arecanut gardens in coastal belt of Odisha.

Indigenous Plant Protection Practices
The shoot borer (*Conogethes punctiferalis*) is the most important pest of ginger. It appears during July-October. The shoots infested by the borer are cut open and the caterpillars are picked manually and destroyed. It has been observed that some farmers are allowed to grow neem trees along with ginger crops to repel the pest. Some farmers are managed shoot borer by pruning of infested shoots. Progressive farmers are applied bio-pesticides (*Bacillus thuringiensis*) to control the insect.

Soft rot or rhizome rot caused by *Pythium aphanidermatum* is a major disease of ginger in Odisha. Farmers are selected the upper area having proper drainage for ginger cultivation. Farmers are also used seed rhizomes from disease free areas since this disease is also seed borne. Farmers are treated seed rhizomes with 0.3 % mancozeb. Some farmers are inoculated with *Trichoderma* at the time of planting as a biocultural measure. It has been noticed that solarisation of seed bed is done by few farmers at the time of bed preparation to reduce the fungus inoculums in the soil. However, if the disease is noticed, the affected clumps are removed by farmers carefully along with the soil surrounding the rhizome to reduce the spread and also drenched the beds with 1% Bordeaux mixture or 0.3% mancozeb to control rhizome rot.

The bacterial wilt caused by *Pseudomonas solanacearum* and managed it by treating the seed rhizomes with streptocycline (200 ppm) for 30 minutes and shade drying before planting in the field. Some pro-
gressive farmers are applied neem cake @ 1 t/ha at planting time and carbofuran 1 kg/ha at 45 days after planting for control of nematode problem in endemic area. Some farmers of Odisha removed the mud from bottom of diseased plants to expose the roots to the sun to reduce diseases (soft rot and wilt) spread. In Kandhamal and Keonjhar rotten plant roots are screeched and wood ash is applied to ginger plot for vigorous growth.

Harvesting And Yield
For fresh Ginger, the crop is harvested before attaining the full maturity means when rhizomes are still tender, low in pungency and fiber content, usually from fifth month onwards after planting. Harvesting for the preserved ginger is done after 5-7 months of planting while harvest for dried spices and oil is best at full maturity i.e. between 8-9 months after planting when leaves started yellowing. For planting material rhizomes are harvested until the leaves become completely dry. After digging the rhizomes are treated with fungicide like mancozeb @3-4 gm per litre of water, dried in shade and stored in pits covered with 20 cm layer of sand alternating every 30 cm layer of rhizomes. These pits are dug under a thatched roof to protect the rhizomes from rain, water and direct sun. Average yield were obtained from 12-15 tons per hectare.

Washing And Drying
After harvest, the fibrous roots attached to the rhizome are trimmed off and soil is removed by washing. Rhizomes are soaked in water overnight and then cleaned. The skin is removed by scraping with the knife. Farmers replied that peeling or scraping reduces, drying time, thus minimizes mold growth and fermentation. However scraping process tends to remove some of the oils constituents which are more concentrated in the peel. By removing the outside Corky skin the fiber content also decreases. After scraping, the rhizomes are sun dried for a 10-15 days with frequent turning and well rubbed by hand to remove the outer skin. The peeled rhizomes are immersed in 2% lime solution for 6 hours and allowed to dry in the sun for 10 days while rhizomes receive a uniform coating of lime with 8-10% moisture content. This is called as bleached ginger which has improved appearance with light bright colour.

Storage
There are 3 traditional storage methods for ginger rhizome in Odisha. They are storage in soil pits, storage in a dry and shaded place and in situ storage. By in situ storage (delayed harvest), farmers harvest the rhizomes according to market demand and allow the rest of rhizomes remain in the field for household consumption. This method is prone for rhizome rot, rhizomes starts sprouting in course of time and harbour insect pests. In pit storage, either a circular or rectangular pit (1-2 m depth) is dug under shade. A thin layer of padd straw is spread over the bottom of pit and rhizomes are placed into this in layers just below ground level. Again a thin layer of straw covers the rhizomes. The final covering is done with the soil little above the ground level. The pits are opened at the time of next sowing season. In this method, the rhizomes were spoiled in two ways, i.e. 25 – 40% rhizome rot in the pit itself and about 10- 20 % rhizomes sprout in the pit and the same unfit for sowing. Pit storage method is the best for small scale farmers. This storage method is adopted by farmers for seed purpose. For seed material, bold and healthy rhizomes from disease free plants are selected immediately after harvest. For this purpose, healthy and disease free clumps are marked in the field when the crop is 6-8 months old and still green. Storage in dry shaded places is economic for the larger growers but there is a problem of rhizome drying. To reduce the spoilage of ginger during storage, healthy ginger rhizomes are selected at the time of harvesting. Selected rhizomes are cleaned, dried in shade and kept in a pit dug in a cool place with the protection from sunshine and rains. A pit of 1 m depth is made and a layer of sand is put 2 cm thick at the bottom of pit. Ginger rhizomes are kept over the sand inside the pit. The pit is covered with wooden planks having some space between rhizomes and wooden planks and coated with cow dung paste. Farmers separated shriveled and disease affected seed rhizomes in pits once in 20- 25 days intervals. By this process, ginger rhizomes could be stored for 4- 5 months with 10- 15% losses. Some of the farmers in Ganjam and Khurda districts used dried leaves of *Strychnos nux-vomica* L. for storage of ginger rhizomes as *Strychnos nux-vomica* L. was found effective for control of rhizome scale.

Storage Of Green Ginger
Big, healthy rhizomes free from diseases are selected and are treated with a solution containing 0.3% Dithane M-45 for 30- 45 minutes. After that farmers are drained the solution and dried the rhizomes in cement floor and under shade of mango tree, jackfruit tree and also sal tree. It has been observed that few farmers are stored fresh ginger in polyethylene bags with 1- 2 kg capacity along with 2% ventilation prevents dehydration and mould development. Dried rhizomes are placed in a pit of convenient size (2m × 1m) and covered with a plank fitted with 2–3 holes for aeration. In some areas, the rhizomes are loosely heaped over a layer of sand or paddy husk and covered with dry leaves of turmeric in a thatched shed.
Status of Technology Adoption For Ginger

Observations revealed that use of high yielding variety, timely planting, raising method of planting and application of fertilizer and recommended doses and suitable intercropping are the major key factor for increasing productivity and per hectare income. It has been observed that 5% of the ginger growers in Odisha used chemical fertilizer and follow raised method of planting as compared to 60% on an average in India. Only 27% of the farmers in Odisha planted ginger in time as compared to 90% of the farmers on an average in India. 7% of the farmers use high yielding varieties of seeds in ginger in Odisha as compared to 15% on an average in India. Since intercropping in ginger is limited to only 155 of the farmers, steps can be taken to increase area under intercropping to reduce risk on crop and to increase income per hectare.

Prospect For Organic Ginger In Traditional Farming System

The consumption of inorganic fertilizers (58.74 kg/ha) and pesticides (158 g/ha) is very low in Odisha than the national average (121.60 kg/ha and 500 g/ha, respectively). Therefore the traditional agricultural system of Odisha is by and large, organic by default. Farmers are increasingly taking up organic ginger cultivation on commercial scale. Organic ginger is now grown in Kandhamal, Keonjhar, Sambalpur and Koraput which could generate employment opportunities in a large scale for tribal people. The government of Odisha is promoting organic ginger cultivation and set up an Organic Model plants with assistance from Agricultural Export and Processing Export Development Authority (APEEDA). Agricultural Export Zone (AEZ) would be established in Kandhamal for organic ginger where a majority of the tribals are cultivated. After five years, an initiative has been taken to reintroduce ginger cultivation in Daringbadi block of Kandhamal district under National Agriculture Innovative Project. The project is implemented with the help of Agriculture Department, financial support of World Bank and technical support of OUAT with an aim to boost the economic status of farmers. Earlier, Daringbadi was known for rich cultivation of ginger. Till 2005, ginger is cultivated on 3,000 hectares on an average in the block through traditional method. Then the cultivation stopped due to lack of incentive and interest from the government side. Under the scheme, the World Bank will provide Rs 26 lakh to be spent on imparting modern training to farmers, holding workshops and taking the farmers on field visits. Besides, the project aims at improving the quality of ginger, increasing its shelf life and adding value to the product. For this purpose hundreds of ginger growing farmers have been identified. Kandhamal Apex Spices Association for Marketing (KASAM), a NGO working in Kandhamal and IAEET, a NGO working in Koraput have taken required steps for promotion of organic ginger among the tribal farmers including Women Self Help Group and ginger marketing. The Ginger Slices product that KASAM offer are completely Organic and healthy. The agency export Ginger Slices about 30 MT per annum to USA, UK, Japan and Germany. The Organic Ginger Slices are rich in flavor and have a wonderful aroma. KASAM has been awarded with the Organic certificate from CUC, Netherlands as recognition of the high quality of products.

Discussion

It has been widely acknowledged that synthetic fertilizers, pesticides and fungicides are more effective and regularly use for the management of crop for yield all over the world. However, these chemicals are harmful to the ecosystem and it also reduces development of micro-bial activities in the soil. Considering all these facts and overcome theses problem, alternative method of crop management using traditional practices is also equally effective tool for crop management. Furthermore, indigenous practices are more popular among tribal farmers in the state. It might be due to low cost and locally available materials. The yield and quality of ginger under traditional methods of cultivation appears to be enhancing by increased microbial activities in the soil and improved nutritional status in the root zone as well as in the plant system. Higher yield and quality under traditional methods of cultivation has also been recorded in turmeric.

Conclusion

Sustainability of agricultural production largely depends on proper development, conservation and use of natural resources at micro level. Ginger is one of the most important spice crops in India however, the productivity is very low due to various biotic and biotic factors. Thus, there is need to increase the productivity to fulfill the domestic requirement and for export. Ginger cultivation is capital intensive and needs more investment. Tribal farmers are incapable to invest required inputs and unable to bear more risks. Ginger is an important cash crop grown by tribal families for their livelihood and more than 50% of the ginger growers are tribals in Odisha. It has been observed that technological interventions like rhizome treatment, soil application of Trichoderma (bio-control agent), wood ash, crop rotation, mulching, plant protection measures managed biotic factors (insect pest and diseases) and increased rhizomes yield by the tune of 20-25% at farmers field as compared to control (Non adopted technology groups). To enhance the productivity popularization of cost-effective, eco friendly production technologies among the farming community are the need of the hour. The indigenous technical knowledge acquired by the
farmers need to be tested and refined with the recommended technologies for increasing farm productivity.

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