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Traditional Cultivation Practices Of Turmeric In Tribal Belt Of Odisha

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Abstract
Turmeric (Curcuma longa L) is an important cash crop grown by tribal farmers of Odisha for their livelihood. Despite the good agro-climatic condition, the productivity of turmeric in Odisha is much below (2.4 t/ha) as compared to national average (5.1 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 turmeric cultivation followed by farmers. Four districts of Odisha namely Nayagarh, Ganjam, Kandhamal and Keonjhar were selected where this crop is grown by the farmers in general and tribals in particular. The sample consisted of 360 farmers including 180 women. It has been observed that a large number of tribal farmers still practice the traditional method of cultivation of turmeric. Turmeric is cultivated in slop with or without terraces and in plains as a sole crop and intercrop. Dughi, Jobedi, Katigia, Local, Lakadong, Ranga, Rasmi and Suroma varieties of turmeric are grown in Odisha. Turmeric is cultivated by the farmers of Odisha for home consumption, seed purpose and for source of income. It has been observed that technological interventions like rhizome treatment, soil application of Trichoderma (bio-control agent) in well rotten cow dung, wood ash, crop rotation, mulching, plant protection measures increased rhizomes yield by tune of 20- 30% at farmers field

Keywords: Turmeric, traditional practices, rhizomes, curcumin, tribal belt, livelihood

Intorduction
Turmeric is an important commercial spice crop grown in India since ancient times and it is named as "Indian saffron". It is known as the "golden spice" as well as the "spice of life." It reached China by 700 AD, East Africa by 800 AD and West Africa by 1200. It was introduced to Jamaica in the 18th Century and started becoming popular throughout the world. Turmeric was probably cultivated at first as a dye, and then became valued as a condiment as well as for cosmetic purposes. The Arab traders took turmeric to Europe in 13th century. During his travels in China in 1280, Marco Polo was so impressed by turmeric that he mentioned it as a vegetable that has properties of saffron, but it is not really saffron. Turmeric is mainly known as a spice all over the world. It is use as a spice in curry powder, chicken bouillon, sauces, gravies, dry seasoning, baking mixes, processed cheese pickles, relishes, breading soup, beverages and confections **(**Sasikumar, 2001). Turmeric is now grown in countries like India, China, Pakistan, Bangladesh, Vietnam, Thailand, Philippines, Japan, Korea, Sri Lanka, Nepal, South Pacific Islands, East and West Africa, Malaysia, Caribbean Islands and Central America. The world production of turmeric is 800000 tonnes in which India hold a share of approximately 75- 80% and consumes around 80% of its own production. India is by far the largest producer and exporter of turmeric in the world. Indian turmeric is considered the best in the world market because of its high curcumin content (6.7%). Turmeric occupies about 6% of the total area under spices and condiments in country. During 2012-2013, the country produced 9,92,900 tonnes of turmeric from an area of 1,95,100 ha **(**Anonymous, 2013**)**. During the period between April 2011 to January 2012, India exported 67,000 tonnes of turmeric valued at Rs 6,438 million. From India's total turmeric exports, 65% exported to UAE, USA, Japan, Srilanka, UK, and Malaysia. Andhra Pradesh, Tamil Nadu, Odisha, Karnataka, West Bengal, Gujarat, Meghalaya, Maharashtra and Assam are important states cultivating turmeric. Andhra Pradesh alone occupies 35.0% of area and 47.0% of production.

In Odisha, turmeric is an important cash crop grown by tribal families for their livelihood and more than 50% of this crop grower is tribals. Odisha contributes about 21 % of India's turmeric cultivation in terms of area and Kandhamal makes up for over 50 % of the state' s share. Odisha produced turmeric 59361 t from 24733 ha. Kandhamal district stands first in turmeric area as well as production (28,828 t from 11,088 ha). Koraput is the second largest producing district (7,761 t from 3,168 ha) followed by Nayagarh (5343 t from 2473 ha) and Keonjhar (2937 t from 1224 ha). Turmeric is a cash crop grown by *Kondha* tribes of Kandhamal district and *Langi Kondha* of Gajapati district. The crop is grown in backyard by the tribals with their indigenous methods of crop production. The crop is mostly produced organically and the farmers get a good return. In view of the potential of turmeric, the state proposed for the Agri Export Zone (AEZ). The zone covers the district of Kandhamal (Ray, 2007).
Turmeric is also credited with religious and magical rites in India and certain South- East Asian countries. Tradi-

tionally turmeric has been used in India for treatment of a variety of human and veterinary ailments, as a natural dye, as well as preparation of delicious dishes. Though traditional Indian Ayurvedic and Siddha systems of medicine have recognized the medicinal value of turmeric in its crude from since very ancient times, the few decades have witnessed extensive research interests worldwide in the biomedical activity of turmeric and its compounds. Thus *Curcuma* is now gaining importance all over the world as a mighty cure to combat a variety of ailments, as the genus carries molecules credited with anti-inflammatory, hypocholestremic, choleratic, antimicrobial, antirheumatic, antifibrotic, antivenomous, antiviral antidiabetic, antihepatoxic and anticancerous properties as well as insect repellent activity **(**Chattopadhya *et al*, 2004) . Turmeric can be grown in Odisha as an intercrop in coconut and areca nut plantations. Turmeric is the third-largest spice exported from India. In terms of quantity and value, it accounts about 12% and 5% respectively. Information on traditional cultivation practices of turmeric in Odisha is not well documented so far. Therefore, an effort was made to assess the current status of the traditional practices followed by farmers in general and tribals in particular for turmeric cultivation in Odisha so that Indigenous Technical Knowledge (ITKs) for cultivation practices of turmeric can be documented and popularized among farmers to enhance productivity with quality.

Methods And Materials

The study was undertaken in Nayagarh, Ganjam, Kandhamal and Keonjhar districts of Odisha during 2011-12 and 2012 -13. From each district, 3 villages were selected where turmeric is being cultivated commercially and stored by the farmers. Skill trainings and exposure field visits were organized for skill up gradation of farmwomen and encouraging their participation in production of turmeric. After preliminary survey, thirty randomly selected farmers from each village were organized into turmeric growing groups (with adopted technology like seed treatment, soil application of biocontrol agent like *Trichoderma* in well rotten cow dung, 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, gender participation, varieties, seed selection, seed treatment and planting, mulching, crop rotation, indigenous 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 preparation

Turmeric is cultivated in slop, from sea level to 1500m above MSL under rainfed condition with or without terracing as well as in plain, in open and under shade of mango (*Mangifera indica* Linn), jackfruit (*Artocarpus heterophyllus* Lam.) coconut (*Cocos nucifera L.*) and arecanut (*Areca catechu* Linn.) and other forest tree like sal (*Shorea robusta* Gaertner f.) in Ganjam, Khurda and Kandhamal. Pigeon pea (*Cajanus cajan.* L.Millsp) and castor (*Ricinus communis* Linn.) are planted by some farmers on the borders and on irrigation channels to provide shade. Humid weather along with 30- 35^{0}C temperature for germination, 25- 30^{0}C for tillering and 20- 25^{0}C temperature is ideal for rhizomes initiation under Odisha condition **(**Panigrahi *et al.*, 1987). It has been observed that growth and yield of crop are higher under mango and jackfruit trees than crop grown under sal tree. Farmers said that mango and jackfruit are providing partial shade which is suitable to the crop for their growth and rhizomes development. In hills farmers are planted turmeric across the slop. Farmers reported that planting of turmeric rhizomes across the slop control soil erosion during rainy season and improved productivity of crop. The land holding was 200sqm in backyard to 1.5 ha. It has been observed that in the hill slopes of Raygada block of Gajapati district pineapple (*Ananas comosus* L.) and turmeric are grown by the farmers with support from the Orissa Tribal Empowerment and Livelihood Programme (OTELP). Farmers reported that both crops are shade loving so that there is no difficulty in growing turmeric with pineapple. Proper spacing timely intercultural operation, appropriate crop combination and required plant protection are adopted by almost all the farmers. Farmers believed that planting of rhizomes in the same piece of land every year does not produce good yield of turmeric. Farmers planted rhizomes on raised bed of about 30 cm height and1m width to avoid water stagnation during rainy season. In the low hills of Kandhamal, Keonjhar and Nayagarh the land is ploughed but in mid hills and sloppy areas it is dug with spade and incorporated FYM. Small farmers in Kandhamal and Keonjhar are applied poultry manure and goat manure @ 5-7 t/ha in backyard cultivation. Weeds, stubbles, roots etc. are removed by men and women. Rhizomes are planted during May- June with the receipt of premonsoon showers.

Varieties

Dughi, Jobedi , Katigia local varieties of turmeric are grown in Odisha. Beside these, *Lakadong*, *Ranga*, *Rasmi* and *Suroma* varieties of turmeric are grown by farmers in Kandhamal of Odisha. Presently crop is

grown organic and considerable area has been brought under *Lakadong* turmeric, considering its high curcumin content. Research efforts in Odisha basically in Koraput have resulted in the evolution of 4 high yielding varieties with good bright colour and high curcumin content (6.7%) viz Rango, Reshmi, Roma, Surma have become popular among turmeric growers. The salient features of important turmeric varieties grown in Odisha are described below .

Roma: Suitable for both rainfed and irrigated condition, suitable for hilly areas and late season planting. Curcumin content 6.1%, oleoresin 13.2%, essential oil 4.2%, dry recovery 31.0% and crop duration 250 days with average yield 20.7t/ ha.

Suroma: Round and plumpy rhizome, field tolerance to leaf blotch, leaf spot and rhizome scale, curcumin content 6.1, oleoresin 13.1%, essential oil 4.2%, dry recovery 31.0 % and crop duration 250 days. Yield was recorded 20.0 t/ ha.

Ranga: Bold and spindle shaped mother rhizome, suitable for late planting and low lying areas, Moderately resistant to leaf blotch and rhizome scales, curcumin content 6.3%, oleoresin 13.5%, essential oil 4.4%, dry recovery 24.8% and crop duration 250 days.

Rasmi: Bold rhizomes, suitable for both rainfed and irrigated condition, early and late sown season, curcumin content 6.4%, oleoresin 13.4%, essential oil 4.4%, dry recovery 23.0% and crop duration 240 days. Average yield (fresh) at farmers field were recorded 31.5t/ha.

Selection Of Seed Materials And Planting Method

It has been observed that farmers are planted rhizomes on raised beds and also on ridges during April- May. Some of the farmers in Keonjhar and Kandhamal districts are planting rhizomes in furrows for that purpose they made furrows with the help of small spade and applied farm yard manure @ 10 t/ ha. After that rhizomes are planted in the furrows at the spacing of 30 cm and covered with soil. Farmers reported that they preferred mother rhizomes at least 100g in weight for planting as they give 50% more yield than finger rhizomes. For backyard cultivation mother rhizomes are used for planting but for medium and large size of cultivation both mother and finger rhizomes are used for planting. The finger rhizomes are cut into 4 - 5 cm long pieces, and the mother rhizomes are planted consisting at least one healthy bud. Well developed healthy and disease free rhizomes are selected for planting. It has been noticed that rhizomes are treated with 0.3% Dithane M-45 for 30 minutes before planting to avoid diseases. This method is adopted by progressive farmers. At the time of planting some farmers applied 25 g neem cake powder and mixed well with the soil in each pit taken at a spacing of 20-25 cm within and between rows. Small pits are made with a hand hoe in the beds in rows with spacing of 25 cm x 30 cm and covered with soil or cattle manure. The optimum spacing in furrows and ridges is 45-60 cm between rows and 25 cm between plants. A seed rate of 2000 -2,500 kg of rhizomes is required for planting in one hectare of land. Small and marginal farmers are used their own seed or collected from villagers but large farmers are also used their own seeds as well as remaining seed rhizomes purchased from public and private nurseries. Farmers are used only healthy, nematode free rhizomes to avoid nematode problem in turmeric.

Mulching

The rhizomes are mulched immediately after planting with sal leaves at the rate of 12-15 t/ha. Mulching (green leaves) is also applied @ 7.5 t/ha at 45 and 90 days after weeding. Farmers reported that mulching in turmeric beds with green leaves is an essential to enhance germination of seed rhizomes and to prevent washing off of soil in rainy season. It also helps to add organic content to the soil and conserve moisture during the later part of the cropping season. Farmers are applied glyrecedia (*Glyrecedia sepium* Jacq.*)* leaves rich in nitrogen content, phosphorus content like acalypha *(Acalypha indica* L.*)* and potassium content like calotropis (*Calotropis gigantean* L.) as mulch. Farmers believed that mulching would increase germination; reduce weed growth and soft rot **(**Rajan, 1999) . It has been observed that organic content of the soil helps to check the multiplication of nematodes. It has been seen that small farmers poured cow dung slurry on the bed after each mulching to enhance microbial activity and nutrient availability. In Kandhamal district sal (*Shorea robusta* Gaertner f.) leaves are collected by women during February and March for mulching purposes.

Crop rotation

Most of the farmers practice crop rotation. The crop rotation is varied from 2-4 years but it is highly depend upon size of the land holding and market price of turmeric. Paddy, potato, brinjal, tomato, bean, elephant foot yam, cabbage, okra, ragi and maize are grown in rotation. It is cultivated as a subsidiary crop to ginger in some areas. However, some farmers also grow turmeric in the same field continuously due to lack of land.

Indigenous Plant Protection Practices

Shoot borer (*Conogethes punctiferalis* Guen.) is the most important pest of turmeric larvae bore into the pseudostem and feed on the growing shoot resulting in yellowing and drying of the infested shoots. The farmers in this state have been followed indigenous pest and dis-

ease management practices. Some farmers plant rhizomes just after burning the field to avoid soil borne disease and insect damage. The adult of shoot borer after emergence from the soil settle on the tree and farmers collected and destroyed them. Farmers reported that spraying neemoil @ 0.5 per cent during July-October (at 21 day intervals) is effective against the shoot borer. Leaf blotch a fungal disease caused by *Taphrina maculans* appears as small oval rectangular brown spots on either side of the leaves. They soon become dirty yellow or dark brown. Tribal farmers removed mud from bottom of diseased plant to expose to the roots to the sun. This practices found to reduce disease (rhizomes rot) infestation. Progressive farmers are also deep ploughed their field during summer to reduce the disease. Rotten plant roots scratched by farmers in Kandhamal and Keonjhar and applied wood ash as well as vermicompost @2 t/ha in field to manage the incidence. Farmers are applied *Trichoderma viride, Beauveria bassian, and pseudomonas* to control rhizome rot. Farmers in Kandhamal district planted turmeric in red soil and under the shade of tree like sal, mango and jackfruit to reduce rhizomes diseases. It has been observed that progressive farmers used own seeds for planting change seed source every 2-3 yrs to reduce the spread of seed borne diseases. Turmeric planted in the red soil was found less incidence of insect pest and diseases during storage period.

Harvesting

The crop is harvested in seven to nine months from January-April. The aromatic type matured in about 7 months and longa type in about 9 months. The main harvest season begins from end of December and extends up to March. Turmeric is harvested when leaves turn yellow and start drying up. In harvesting, the whole clump is lifted out with the dry plant, then the leafy tops are cut off, the roots are removed, all the adhering mud particles are removed and the rhizomes are then washed well with water. Harvesting of turmeric is done after pre monsoon rain. After rains soil is become loose and digging of turmeric rhizomes is easy. It has been noticed that farmers are harvested turmeric every year but some farmers are harvest delayed (by *in situ* method) the rhizomes according to market demand and allow the rest of rhizomes remain in the field for maintain its curcumin content. Harvesting of turmeric is done by the farmers with the help of small spade. Usually the land is ploughed and the rhizomes are gathered by hand. The average yield (green turmeric) were recorded 10- 16 t/ha at farmers field. The fingers rhizomes are separated from the mother rhizomes by men and women and kept in shade for 2-3 days. The mother rhizomes are kept for seed purpose and finger rhizomes are cured for selling.

Curing And Drying

In traditional method of curing, rhizomes of turmeric are boiled in aluminum pots with 20 kg capacity along with ¾ water for 45- 60 minutes, depending on the quantity. The pots are covered with a lid. Boiling process is continued till white froth appears with a special quality flavor. Cooking process is completed when rhizomes become soft and inner colour turns yellow. Over cooking spoils the colour of the final product while under-cooking renders the dried product brittle. Mother and finger rhizomes are cured separately. Boiled rhizomes are dried in the sun by spreading them in 5-7 cm thick layers on bamboo mats or ground floor for 10- 15 days. The rhizomes are stirred 2-3 times to ensure uniform drying. Improper drying results in the rhizomes become hard or brittle. A thinner layer is not desirable, as the colour of the rhizomes adversely affected. During night time, the rhizomes are heaped and covered with sal and turmeric leaves. This method of processing is adopted by tribals *Kondha.*

Storage: The cured rhizomes are stored by farmers in pits of 4 x 3 x 2 m size. Pits are dug in elevated place and sun dried for one week; bottom and sides of the pits are thickly lined with grass or Palmyrahmats. Subsequently cured produce is filled in pits and is covered with mats and finally with earth. The seed rhizomes are stored for 3-4 months from harvesting to planting by spreading them thinly under a cover of turmeric leaves. For storage seed rhizomes are also stored by heaping them under the shade of trees. Heaps are covered with turmeric leaf and plastered with soil and cow dung mixture. It has been noticed that rhizomes are treated with bavistin fungicide @ 2gm/L of water solution for 15 minutes before storage to avoid fungal diseases during storage. It can be left undisturbed for 2 - 3 months until sowing. In Kandhamal district, farmers stored turmeric in the field and also in backyard under the shade of mango (*Mangifera indica* Linn), jackfruit (*Artocarpus heterophyllus* Lam.). As tree protect rhizomes from heat and rains and also create micro environment to enhance the shelf life and reduce the losses. For that purpose pits are dug about 1 m size and place the rhizomes of turmeric 40- 80 kg and covered by sal (*Shorea robusta* Gaertner f.) and turmeric (*Curcuma longa* Linn*)* leaves. Farmers said that sal and turmeric leaves were found effective for control of termites. The traditional practices and control of post harvest losses by traditional methods of storage has also been obtained in turmeric (Killendar *et al*, 2011 & Shankar, 2006)**.**

Prospect for organic turmeric in traditional farming system

The consumption of inorganic fertilizers (53.20 kg/ha) and pesticides (143g /ha) is very low in Odisha as compared to national average (121.60 kg/ha and 500 g/ha, respectively) (Rai *et al*, 2011). Therefore, the scope of

production of turmeric organically in Odisha is high. Farmers are increasingly taking up organic turmeric cultivation on commercial scale due to higher demand in local as well as in International markets. Organic turmeric is now grown in Kandhamal, Keonjhar, Raygadha and Koraput. The government of Odisha is promoting organic turmeric cultivation in tribal area and set up an Organic Model plants with assistance from Agricultural Export and Processing Export Development Authority (AEPEDA). Agricultural Export Zone (*AEZ)* would be established in Kandhamal for promoting organic turmeric among tribals. Kandhamal Apex Spices Association for Marketing (KASAM) took initiative and organized the 61 turmeric growing societies and now it has 12,000 tribal farmers with 68 women self help groups. Odisha Development Action Forum (ODAF) is also promoting organic turmeric cultivation and marketing through women Shelf Help Groups (SHGs) in Kandhamal. The total export value of Kandhamal Organic Turmeric product was Rs 1.25 crore during 2007-08. Kandhamal Turmeric is an important product and now become popular in the organic food market of Europe and North America. It is an organic product with certified by SKAL Netherland with "EKO". During cultivation, no chemical fertilizers, pesticides are used. No artificial colours and essence are added to it. It is best for health and skin care. As a result, it has gained good market share in International and Local market. Kandhamal Apex Spices Association for Marketing Kandhamal (KASAM) and Orissa Milk Federation (OMFED) are promoting organic turmeric cultivation and its marketing in Odisha.

Gender Participation In Turmeric Cultivation

Men and women were involved in almost all the activities from land preparation to storage. However their role depends upon family situation than on gender, ethnicity and level of income. In a family with more men member, men work in the field, whereas in family with fewer men, women work equally with men. Ploughing of field is done by men while digging and hoeing are done by both men and women. Application of manure, planting, collection and preparation of solution for plant protection, mulching, harvesting, storage and retail selling are done by men and women. Sal and turmeric leaves for heap/ pit storage and mulching of rhizomes are collected by women. As women are the ones who have traditionally been collected these products (Mishra, 2005). Study revealed that after harvesting turmeric rhizomes, grading and cleaning are done by the women. Weeding is done by women although men help as when required.

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 microbial 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 turmeric 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 (Swain *et al*, 2007).

Conclusion

Turmeric is one of the most important spice crops in India however, the productivity is very low. Thus, there is need to increase the productivity to fulfill the domestic requirement and for export. Turmeric cultivation is capital intensive and needs more investment. Tribal farmers are incapable to invest required inputs and unable to bear more risks. Turmeric is an important cash crop grown by tribal families for their livelihood and more than 50% of the turmeric growers are tribals in Odisha. It has been observed that technological interventions like rhizome treatment, soil application of *Trichoderma* (biocontrol agent), wood ash, crop rotation, mulching, plant protection measures increased rhizomes yield by 20-25% at farmers field. 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 modern techniques. This will help the farmers to increase the productivity from their existing system.

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