The past literature helps one to adopt, modify and improve the conceptual frame work and acts a guideline for the present study. Hence, an attempt is made in this chapter to review the earlier studies on issues relevant to the research problem undertaken. The review covers both national and international studies.

Rao K. S. and Moorthy B. T. S., (1994) conducted a field experiment during the summer seasons of 1991 and 1992 on alluvial sandy-loam soils of Cuttack (coastal region of Orissa) to identify a suitable high-yielding variety of groundnut (Arachis hypogaea L.) in rice (Oryza sativa L.) fallows and suitable technology for higher productivity of the crop. The promising varieties were 'R 8808', 'ICGS 11' and 'DRG 12' with mean yields of 3.55, 3.33 and 3.26

tonnes/ha respectively. The crop sown at the spacings of 40 cm X 10 cm (250 000 plants/ha), 30 cm X 10 cm (333 000 plants/ha) and 20 cm X 15 cm (333 000 plants/ha) gave significantly higher yield (2.60, 2.79 and 2.82 tonnes/ha respectively) than that grown under the spacings of 20 cm X 10 cm (500 000 plants/ha). 30 cm X 15 cm (222 000 plarus/ha) and 40 cm X 15 cm (166 666 plants/ha). The crop responded to gypsum @ 500 kg/ha applied 30 days after germination, and to P @17.46kg/ha applied at sowing.

Mahajan T.S., et.al. (1994) conducted a field experiment during the winter seasons (rabi) of 1988-89 and 1989-90 on lateritic soil to study the effect of boron on yield and quality of 'SB 11' groundnut (Arachis hypogaea L.). The treatments were: T_1, no boron; T_2, soil application of n @ 0.5 kg/ha through horonaled superphosphate; T_3, 0.5 kg/ha through borax.; 14, 1.0 kg/ha through borax; T_5, 1.5 kg/ha through borax; and T_6, B @ 0.5 ppm in Z foliar sprays. Treatment T_2 gave significantly higher yield of dry pods (3200 kg/ha) and harvest index (42.84) than all other treatments. It also gave significantly higher yield of oil (1 156 kg/ha) and protein (659 kg/ha) and showed higher uptake of nitrogen (127.4 kg/ha) and phosphorus (11.7 kg/ha) in-kernels than T_2, T_3, T_4 and T_5.

Murali Baskaran R.K., and N.R Mahadevan (1994) studied the relationship between weather factors and light-trap catches of leafminer (Aproaerema modicella Deventer) of groundnut (Arachis hypogaeo L.) during 1987, 1988 and 1989 at Vridhachalam. The number of moths attracted to light-trap was significantly high in second fortnight of August and September in 1987 (11 peak catches) in first fortnight of October in 1989 (7 catches) and in March and first fortnight of April 1988 (6 catches). Pooled analysis of data

revealed that the light-trap catches had a negative association with maximum temperature (r = -0.18). minimum temperature (r = -0.01) and sunshine hours (r = -0.18), and a positive association with relative humidity (r = 0.24) and rainfall (r = -0.41). The correlation studies indicated that rainfall alone exerted a significant positive influence, and an increase of 1 mm rainfall would increase the leafminer adults by 8.9.

Devi Dayal et.al. (1994) conducted a field experiment during the rainy seasons (kharif) of 1988 and 1989 at Junagadh to assess the effect of 3 row patterns and 6 weed-control methods on weed growth, yield and economics of rainfed groundnut (Arachis hypogaea L.). Paired row pattern significantly reduced the weed growth at 60 days after sowing and at maturity of groundnut compared with normal row spacing. Paired row of 30-60-30 cm (spacing within pair 30 cm, and between pairs 60 cm) x 10cm showed significantly higher weed-control efficiency (55.69%) than normal row pattern (48.34%). Pooled data of row pattern indicated that recommended weed-control method (pre-emergence application of fluchloralin @ 1.50 kg/ha + 1 hand-weeding at 30days after sowing) showed weed-control efficiency equal to that of weed-free treatment. The maximum pod yield (2 254kg/ha) and net return (Rs 7 105/ha) with a benefit: cost ratio of 3.30 were recorded by paired row of 30-60-30 cm x 10 cm. Irrespective of the row pattern, reduction in the quantity of herbicide significantly reduced the weed-control efficiency, pod yield and net return compared with the recommended weed-control method.

Satish Chandra et.al. (1995) conducted an experiment during the rainy season of 1991-93 to evaluate 25 genotypes of groundnut (Arachis hypogaea L.) for their resistance and stability to disease reaction of early leaf-spot

(Cercospora arachidicola Hori) at Barapani. . Disease severity was moderate in 1991 and 1992, whereas it was high in 1993 causing heavy defoliation in the susceptible control ('JL 24'). All the genotypes showed less early leaf-spot scored compared with the control, indicating satisfactory level of resistance. Significant genotype X environment (G X E) interaction was observed for disease reaction. Both linear and non linear components of GxE interaction were significant. Genotypes 'ICGV 86020', 'ICGV 86680' and 'ICGV 87350' were found stable and promising for low-disease reaction in different years.

Rafey.A and Prasad.K, (1995) conducted an experiment during the rainy season of 1989-91 at Ranchi to study the effect of weed-control on weed growth, yield and yield attributes of rainfed groundnut (Arachis hypogaea L.). Pre-emergence application of pendimethalin (1.5 kg ai/ha) butachlor (1.5 kg ai/ha) and oxyfluorfen (0. 1 kg ai/hal was comparable with hand-weeding twice (15 and 25 days after sowing) in reducing weed density and its dry weight as well as in increasing pod yield/plant. Maximum dry-pod yield (1800 kg/ha) was obtained under hand-weeding twice and it was on a par with that under pre·emergence application of oxyfluorfen (1626 kg/ha). Among the chemical weed-control methods, pre-emergence application of oxyfluorfen had the least weed index (9.7%), followed by pendimethalin (1.5 kg ai/ha pre-emergence (11.6%). It was also found most economical, giving highest net profit (Rs 3764/ha), followed by hand-weeding twice (Rs 3 416/ha).

Nirval B.G. et.al (1995) conducted a field experiment during the rainy season of 1983-84 to 1992-93 to study the performance of important rainfed crops sown on different dates under different rainfall patterns. The dry sowing

on 15 June of important rainfed crops proved advantageous. viz sorghum [Sorghum bicolor (L) Moench] Rs 10 346/ha. upland cotton (Gossypium hirsutum L.) Rs 9 846/ha, pearl millet [Pennisetum glaucum (L.) R. Br. emend. Stuntz] Rs. 4 112/ha, sunflower (Hehanthus annuus L.) Rs 6 905/ha, castor (Ricinus communis L.) Rs 5 235/ha, pigeonpea [Cajanus cajan (L.) Millsp.] Rs 9 992/ha, groundnut (Arachis hypogaea L.) Rs 10 811/ha and sesame (Sesamum indicum L.) Rs 5 498/ha. The next-best period was sowing immediately after commencement of rains in normal, above-normal and below-normal rainfall situations. The sowing of crops like castor could be extended up to 30 July under normal and above-normal conditions, whereas that of pigeon pea and pearl millet could be extended up to 30 June in all the rainfall situations without much reduction in their yields and total monetary returns/ha. Most of the rainfed crops gave good performance when sown on 15 June or immediately after rainfall. The crops like sorghum, upland cotton, groundnut and sesame when sown after 30 Juno under all the rainfall conditions gave much less yield and monetary return.

Ashok Kumar et.al. (1995) conducted a field experiment during the rainy season of 1990 and 1991 to study the production potential of rain fed pearl millet [Pennisetum glaucum (L.) R Br. emend. Stuntz] + castor(Ricmus communis L.) intercropping at different levels of fertility. Data on castor-seed yield revealed that pearl millet for grain + castor gave better environment for castor to grow than pearl millet for fodder + castor Sole castor, however, proved best for the individual yield, whereas intercropping of pearl millet for fodder + castor was the best for pearl millet-grain-yield equivalent, followed by

pearl millet for grain + castor. Sole crop of castor was not found remunerative. Soil-fertility levels improved the plant height, dry-matter accumulation, yield attributes and yield of pearl millet and castor linearly. Application of farmyard manure@ 10 tonnes/ha was found superior to the control only. Application of 2 bio-fertilizers. ie Azostrithum and vesicular arbuscular mycorrhiza. also showed favourable response in dry-matter accumulation and yield. In terms of pearl millet-grain- equivalent yield and gross return. 40 kg N/ha + 8.80 kg P/ha proved statistically superior to 20 kg N/ha + 4.4 kg P/ha.

Patra G.J., et.al. (1995) conducted an experiment during 2 rainy (kharif) and 2 winter (rabi) seasons and 1summer season (starting from rainy season 1989) to study the performance of 10 varieties of spanish bunch gruundnut (Arachis hypogaea L. ssp fastigiata Waldronvar vulgaris Hartz) for pod and kernel yields, shelling (%). sound mature kernel (%) and 100·kernel weight. The difference between the varieties was significant for shelling (%). sound mature kernel (%) and 100·kernel weight. On the basis of 5characters, varieties 'Kisan', 'Jawan', 'Girnar 1' and 'OG 52-1' were found superior to the others by 26%. 'CGS11' was found stable for 4 characters (pod and kernel yields, 100·kernel weight and sound mature kernel %) and 'Kisan'.'Jawan' and 'ICGS 44' for 3 characters (pod and kernel yields and sound mature kernel %), whereas the remaining varieties were found stable for 1 character each.

Sarkar R.K., et.al. (1997) conducted a field experiment during the winter season of 1992-93 and 1993-94 at Nimpith to evaluate the intercropping systems of pulse crops greengram (Phaseolus radialus 1.), blackgram (Phaseolus mungo L.) and oilseed crop groundnut (Arachis hypogaea L.) with sunflower (Helianthus annuus L.) in 2 planting patterns.

Intercropping reduced the growth and yield attributes .and yield of component species compared with the respective pure stands but increased the plant height of the base crop. The seed yield of sunflower was higher in normal planting (45 cm) than in intercropping, but the total seed-equivalent yield of sunflower was the highest (2646 kg/ha) in paired row (30-60 cm) sunflower + groundnut system. This treatment also gave the maximum land-equivalent ratio (1.44), monetary advantage (Rs.4010/ha) and indicated modest competitive ratio (1.47 : 0.67), which proved the most efficient system.

Mohanty S.K. et.al. (1997) conducted a field experiment during winter season of 1993-94 at Bhubaneshwar to assess the efficacy of herbicides on groundnut (Arachis hypogaea L.) and to compare their relative effect with that of hand-weeding. Fluchloralin as well as pendimethalin bad better effect than hand-weeding in respect of most of the growth parameters. However, maximum augmentation in yield was obtained in fluchloralin (0.7S kg ai/ha) followed by pedimethalin and hand-weeding. The protein and oil yields were also found highest in fluchloralin treatment.

Patel S.R. et.al. (1997) conducted a field experiment during the rainy season of 1994 and 1995 at Raigarh to study the efficiency of different herbicides in rainfed groundnut (*Arachis hypogaea* L.). The herbicides were applied as pre-planting incorporation, pre-emergence to control annual weeds especially coxcomb (*Celosia argentea* L.). The major weed species observed in the field were coxcomb, barnyard grass (*Echinochloa crus-galli*(L.) Beauv.],jungle rice (Echinochloa colona (L.)Link], bermuda grass[*Cynodon dactylon* (L.)Pers and purple nutsedge (*Cyperus rotundus* L.) in decreasing order. Oxyfluorfen @ 0.4 kg ai/ha as pre-emergence showed maximum weed-

control efficiency, particularly for coxcomb and minimum weed index (92.3 and 13.2% respectively) but lagged behind the control (Weed-free plot)in pod yield. The pod yield under the control and oxyfluorfen was 1 561 and 1 361 kg/ha respectively. Lactofen @ 0.15 kg ai/ha applied as post-emergence recorded weed-control efficiency of 53.2, but was inferior in pod yield to pendimethalin @ 1.5 KG ai/ha as pre-emergence and fluchlorlin @ 1.0 kg ai/ha as pre-planting incorporation, which recorded 1 182, 1327 and 1 314 kg/ha pod yield respectively.

Reddy P .S., and D. Pati (1998) considers that the production and productivity of bulk of the oilseeds as well as the availability of vegetable oils in India are largely influenced by 9 annual oilseed crops, viz groundnut (Arachis hypogaea L.), rapeseed-mustard, sesame (Sesamum indicum L.), sunflower (Helianthus annuus.L), safflower (Carthamus tinctorius L.), soybean [Glycine max (L.) Merr.], niger [Guizotia abyssinica (L.f.) Cass.], castor (Ricinus communis L.) and linseed (linum usitatissimum. L.). There was a tremendous increase in the growth rates of area, production and productivity in each of the oilseed crops during the post-TMO periods. The productivity gains, in each of the crops have come about primarily due to adoption of better technologies by the farmers. The latest technology, packages developed in each of the oilseed crops are given which include recently released varieties and recommendations under crop production and protection. The improved technology tested at the farmers' fields under the project Frontline Demonstrations in Oilseed Crops showed the beneficial impact of improved technologies over the farmers' practices. The incremental benefit: cost ratio clearly showed that the technologies are cost effective. As

such, substantial improvement in oilseeds production can be achieved even if the existing technologies are adopted partially by the oilseeds farmers.

Sudheer Kumar S. and Patel S.A. (1999) conducted a study during kharif 1995 to estimate the relative importance of additive, dominance and epistatic gene effects in the inheritance of pod characteristics in 4 groundnut (Arachis hypogaea L.) crosses at the University, Anand. Most of the pod and seed characters were governed by additive genetic effects in crosses between Spanish bunch and virginia runner('Chico' X 'JSP 23' 'Chico' x 'GG 11'). In spanish bunch and virginia bunch cross ('Chico' X 'TMV 1O') pod length and pod width were governed by additive gene effects while 1O-pod weight, 1OO-kernel weight and shelling out-turn were governed by duplicate type of epistasis. In cross between 2 spanish bunch parents all the other traits barring 1O-pod weight and 100 -kernel weight were governed by additive and x additive type of gene effects. In all the crosses except 'Chico' X 'TMV 10' selection for pod and seed characters can be practiced following pedigree method of breeding.

Ajmer Singh Brar et.al. (1999) conducted a field experiment during summer season of 1995 and 1996 to study the phenology and heat unit requirement of the groundnut (Arachis hypogaea L.) genotypes as influenced by 2 dates of sowing. The 2 groundnut genotypes, viz 'M 13' and 'M 335' being of longer duration accumulated higher growing degree days, helio-thennal unit and photo-thermal units at all the phenophases than the 'M 522', 'SO 84' and local genotypes. 'SO 84' the short duration bunch genotype attained harvest maturity 5-10 days earlier than the other 4 genotypes and trans-located highest dry-matter towards pods at 93 and 114 days, while total

dry-matter/plant was maximum in ’M 522’ during both the years. The date of sowing did not influence the various phenophases of any genotype.

Roy B. C., and Shiyani R. L., (2000) made an attempt to identify and prioritize production constraints in rainfed groundnut production system and to explore major researchable issues. To achieve sustainable increase in crop productivity the authors say that it is important to improve the efficiency of all critical inputs particularly water. Intelligent management of water resource will be particularly critical for the sustainability, productivity and dependability of crop production in decades ahead. This can be achieved through introduction of short duration and drought tolerant crop cultivars, mulching to reduce evaporation, land leveling and optimum irrigation scheduling.

Kale D.M. et.al (2000) conducted an experiment by crossing a selected ’TG 19’ having large pods, low yield and dormancy with high yielding cultivars ’TAG 24’ and ’TG 26’ 8 true breeding selections with large kernels, designated as TGLPS 1-8 were established in F_5 generation. In the evaluation trials for 4seasons, they showed superior yield over the large kernel checks, ’TKG 19A’ and ’BAU 13’. To confirm their superiority for large kernel size, studies were made by taking 100-kernel weight and also by image analysis. Among the 8 selections TGLPS 2, 3, and 7 were found to have all desirable traits such as early maturity, high yield, and greater proportion oflarge kernels (>=80g 100) and lacked dormancy. Due to lower oil content, they may suit for table purpose and fit into local cropping systems due to early maturity and absence of dormancy. Further evaluation of these selections will be done in the coordinated varietal trials.

Misra J.B. et.al (2000) conducted a study during 1995-97, 2 winter and 2 rainy seasons on 18 groundnut cultivars to evaluate their worthiness for export. Kernel yield along with observations on physical and chemical attributes of kernels was recorded. The physical attributes studied were sound-mature kernels, shape of kernels, seed size uniformity, 100 seed-mass and colour of testa, while among the chemical attributes that were oil, protein, sucrose, reducing sugar, and free amino acid co9ntents. The oil was analyzed for its fatty acid composition. The cultivars were finally evaluated on the basis of the relative desirability of various physical and chemical traits *vis-a-vis* kernel yield. Cultivar 'ICGS 76' ranked first in kernel yield, fifth for physical attributes and fourth for chemical attributes, and was thus identified as the most suitable cultivar for the handpicked and selected trade. Cultivars 'ICGS 44' and 'ICGS 11' which both significantly higher than average kernel yields were adjudged to be high yielding cultivars with moderate physical and chemical attributes."TGK 19A' an average yielder was adjudged to be the best for physical and chemical attributes and was followed by 'ICGS 11' in the same category. Although the popular cultivar 'GG2' gave significantly above average yield it ranked low in physical and chemical attributes.

Patra A.K. and Nayak B.C. (2001) conducted an experiment during rainy (kharif) season of 1997 and 1998 to study the different weed-management practices on groundnut (Arachis hypogaea L.). Pre-emergent application of Alachlor @ 2 kg ai/ha or Fluchloralin @ 1.0 kg ai/ha or Pendimethalin @ 1.0 kg ai/ha, followed by post-emergent application of Fluchloralin @ 1.0 kg ai/ha 1 day after inter-culture at 20 days after sowing

increased pod yield 94.1,89.3 and 88.0% respectively over the unweeded control (810 kg /ha). The respective net monetary returns were Rs 7916, Rs 8528 and Rs 8341/ha compared with Rs 770 with un weeded control and Rs 5 467 with farmers' practice of hoeing and weeding at 20 days after sowing. Integrated weed management involving pre-emergent application of Alachlor @ 2 kg ai/ha at 1 day after sowing, followed by post-emergent application of Fluchloralin @ 1 kg a i/ha at 1 day after inter-culture recorded higher weed control efficiency (87.9%).

Kotur S.C. and Keshava Murthy S.V. (2001) conducted a field experiment during 1999 to study spatial and temporal distribution of root activity in 'Surya' papaya (Carica papaya L.) a hybrid, using 32 P soil-injection techniques. The crop was raised all loamy sand soil (Typic Haplustalt) belonging to Thymugondlu series. During the early vegetative and flowering stage (2-6 months after planting) the active roots grew up to 60 cm radial distance and 30 cm depth. Of these, 75.2-91.6 % occurred up to 40 cm distance. While 54.3-79.3% were found up to 15 cm depth. During the early fruiting stage (7-10 months after planting), the roots further extended to 100 cm distance and 45 cm depth but bulk of the roots (marc than 70%) still remained within 60 cm distance and 30 cm depth. During the peak fruiting stage (11-14 months after planting), the root activity spread uniformly throughout the soil volume of 100 cm distance and 45 cm depth. The textural horizon (Bt) at.20 cm depth and below did not hamper root growth, as the soil was kept moist throughout by rainfall or irrigation.

Langat M.C., et.al. (2006) carried out a study at Busia Farmers' Training Center during the short rains of 1998 and long rains of 1999. The objective of the study was to come up with groundnut - sorghum intercropping spacings that are appropriate in land use efficiency, yield, and monetary returns compared to mono-cropping. It comprised six treatments: four intercrops (GS1-4) and two sole crops of groundnut (G) and sorghum (S). The trial was laid out in a randomized complete block design with four replications. The populations of groundnut and sorghum in the intercrop affected their performance. As per the study the highest sorghum grain yield (3846 kg/ha) was found in GS4 (two groundnut rows alternated with two sorghum rows) in 1998 and in GS3 (one groundnut row alternated with two sorghum rows) with 3825 kg/ha in 1999. The highest groundnut yield was realized in GS2 (two groundnut rows alternated with one sorghum row) with 1045 kg/ha in 1998 and (790 kg/ha) in 1999. In terms of land use efficiency, GS4 was the best pattern, with LERs of 2.12 (1998) and 2.01 (1999). Similarly, the highest cash returns were also from GS4 in both seasons. Therefore, for maximum use of land and with no crop preference, GS4 is the best combination to use. However, if priority is to maximize sorghum yield, then GS3 is recommended.

Vanaja M. et.al. (2006) conducted a study with two important rainfed food crops *viz*., sorghum (*Sorghum bicolor* L. Moench.) and blackgram (*Vigna mungo* L. Happer) and two oil seed crops *viz*., sunflower (*Helianthus annuus* L.) and groundnut (*Arachis hypogaea* L.) under two conditions *viz.,* elevated CO2 (600 ppm) and ambient CO2 (365 ppm) in open top chambers (OTCs). The results showed significant differences between crops, conditions and time intervals, as well as the single and double order interactions for all the

characters studied *viz*., total dry weight, stem dry weight, root dry weight, leaf dry weight, shoot length, root length and leaf area. Total dry weight and its components *viz.,* stem dry weight, root dry weight and leaf dry weight along with leaf area showed a significant increase under enhanced CO2 conditions. Among the four crops studied the overall results showed the highest response to elevated CO2 by blackgram while the lowest response by sorghum.

Nayak SC, et.al. (2009) in their study shows that the application of secondary and micronutrients to soil and seed dressing increased the pod yield, shelling outturn and oil content over control in both the agro-climatic zones. The mean increase in pod yield in different treatments at both the locations ranged between 9 and 31% over recommended NPK. The maximum yield of 1.52 t ha^{-1} was obtained with soil application of Zn, B and Mo which is statistically similar to that obtained with application of Zn, B and S. However, this treatment produced the maximum shelling outturn of 72% and oil content of 38.4%, which were statistically similar to data obtained with soil application of Zn, B and Mo. The positive response of micronutrients with recommended NPK can be attributed to the availability of sufficient amount of plant nutrients throughout the growth period, resulting in better uptake and yield advantage.

Srinivasarao Ch., et.al. (2010) make a study in Dupahad cluster of Nalgonda district, in Andhra Pradesh, which is predominant tribal inhabitation, and which suffered severe drought during 2009 kharif. As per the authors the onset of monsoon was delayed by two months and the total amount of rainfall received was about 200 mm as against the normal of about 850 mm. This lead to wide spread distress among tribal farmers who, by and large, practice subsistence farming. To meet this adverse season, two drought tolerant and

short duration crops (sorghum and horse gram) were introduced as a contingency measure. These crops were cultivated with minimum nutrient application and addition of organic manure (FYM). Timely implementation of contingency crop plan resulted in net profits to the extent of Rs. 20000/- per ha in sorghum and up to Rs. 16000/-per ha in horse gram. Besides the grain, crop residue obtained from these crops met the food and fodder requirements of tribal families while the villages in the neighbouring hamlets suffered due to drought. This paper outlines the methodology in executing contingency plan during drought and documents its impact on poor families in the nine tribal hamlets.

Maruthi Sankar G.R., et.al. (2010) conducted permanent manorial trials in a fixed site for 22 years during kharif 1985 to 2006 (July to November) to study the effects of rainfall, soil moisture and soil fertility on groundnut pod yield in a shallow arid alfisol at Anantapur. Nine fertilizer treatments with combinations of organic N through groundnut shells (GS) and Farm Yard Manure (FYM) and inorganic N, P and K were applied every year. The treatments differed significantly from each other in all years except 1992, 1996, 2000, 2002 and 2006. Observations were recorded on rainfall received from sowing to harvest; soil moisture at 30, 60 and 90 days after sowing (DAS); and soil test values of organic carbon, P and K and used for modeling of yield over years. The treatments had a better sustainability in the range of 33.4 to 45.9% based on regression model of yield through soil fertility compared to 27.6 to 35.3% through rainfall; and 24.8 to 32.9% through soil moisture variables. 100% N (GS ~ 20 kg N/ha) + 50% NPK (10–20–20 kg/ha),

100% N (GS ~ 20 kg N/ha) and 50% N (FYM ~ 10 kg N/ha) were efficient based on mean, coefficient of variation and sustainability yield index. 100% N (GS ~ 20 kg N/ha) and 100% N (GS ~ 20 kg N/ha) + 50% NPK (10–20–20 kg/ha) were equally efficient, while 50% N (FYM ~ 10 kg N/ha) was the next best treatment for attaining sustainable groundnut yield under shallow arid alfisols.

Sharma K.L., et.al. (2010) conducted experiments on the impact of long-term use of soil and nutrient management treatments for Dryland agriculture in Anantapur district. In experiment 1, the long-term integrated nutrient management treatments tested under groundnut system significantly influenced most of the soil quality parameters. The soil quality indices as influenced by different integrated nutrient management practices varied from 1.32 to 1.96 across the management treatments. The key soil quality indicators identified under this system along with their percent contributions were: EC (7%), OC (17%), available N (4%), available K (16%), exchangeable Ca (16%), exchangeable Mg (16%), DTPA- Fe (6%), DTPA-Zn (2%), and dehydrogenase activity (DHA) (16%). In experiment 2 comprising of tillage practices and nutrient management treatments using groundnut as test crop, the soil quality indices varied from 2.01 to 2.7. The parameters which emerged as key soil quality indicators were: pH, EC, exchangeable Ca, Mg, DTPA- Fe, available B, DHA and labile carbon (LC). Of all the indicators, LC played a major role in influencing or aggrading the quality of the soils followed by soil pH. Among the tillage practices, low tillage played a significant role in improving the soil quality (SQI 2.43) and proved superior, followed by

conventional tillage practice (SQI 2.37). Among the nutrient treatments, sole 100% organic treatment (SQI 2.62) proved quite superior in improving the soil quality followed by conjunctive nutrient application viz., 50% organic + 50% inorganic (SQI 2.35). While the sole 100% inorganic nutrient application could maintain SQI value only up to 2.10. In experiment 3, where groundnut-castor was the crop rotation, soil quality indices varied from 0.85 to 1.73 across the treatments. The key soil quality indicators identified for groundnut-castor system along with their percent contributions were: EC (23%), available P (21%), available S (22%), available B (9%), LC (21%) and MWD (4%). Application of 100% N (inorganic) maintained significantly highest soil quality with SQI value of 1.73, followed by application of 50% N through gliricidia loppings + 50% N through inorganic source (SQI 1.52). This observation clearly indicated the proportionally equal and important role-played by EC, available P, available S and LC in influencing the quality of these Alfisols under castor-groundnut rotation.

Ram M., and M.R. Davar (2010) considers that the mineral resources like limestone, gypsum, sand stone, dolomite, calcite, silica sand, marble, etc. and fossil fuels such as crude oil, oil shale, sand tar, coal and natural gas are other natural resources in dryland areas. Systematic and planned mining operations, suitable site selection for waste disposal, proper exploration and utilization of these resources would help in socio-economic development of the dryland areas.

Sharma K. D.,(2011) considered that Rain-fed agriculture will play a major role in India’s food security and sustainable economic growth, and there are large opportunities for gains from adaptation and new investments in

water management for meeting the targets under the proposed National Food Security Act. The analysis has shown that with a single supplemental irrigation of 100 mm depth in a rain-fed area of 27.5 m ha, additional annual production enhancement of food grains of the order of about 9.3 mt could be achieved. Significant production improvements could also be realized in cotton, sesame, groundnut, soybean and chickpea.

Venkatesh A., (2011) considers that the livelihood support options in rural India are limited. This leads to migration, unemployment, poverty and exploitation of rural people. Fortunately, in Bundelkhand region, Palas (Butea monosperma) naturally regenerates on wastelands, field bunds and extensively used as firewood, leaf mulch and for gum extraction. The species is a known host of lac insect (strain Rangmi). Therefore, attempts were made to introduce lac cultivation in the region which was successful but insect could not be perpetuated for regular inoculation. Gum extraction practice common in the region from B. monosperma is documented in this paper. Efforts were also made to derive livelihood for rural poor through institution building. Out of 4 SHGs constituted in study area, only one SHG could succeed in its endeavour. This, Maa Shitla SHG of Garhkundar constituted of 10 female members from SC community. During their journey from 2006-07 to till date, they have accrued assets and cash worth ‘ 74,000 plus. They meet regularly at weekly interval and contribute‘ 10 each member, discuss business and maintain bank account. They are successfully running inter-personal loaning to meet group demand and enrich SHG, at affordable rate of interest. They started incense stick making as group activity but could not continue due to

low returns. Further, they purchased one diesel pump to rent out which they disposed off after making small profit due to management difficulty. In the year 2008, when there was heavy downpour, the group and one individual attempted aquaculture in two check dams but incurred loss due to number of reasons and gave up the activity in subsequent years. In 2009, they started tent house business as group activity and successfully running and making profit out of it. They are strengthening the activity as part time livelihood support option on regular basis. This venture appears to be sustainable for this group because no such tent house facility is available in nearby villages. There is need to find out such viable ventures which can be promoted as livelihood support options in rural India where job opportunities are less.

Rao V.U.M., et.al. (2011) calculates that nearly 80 per cent of the area under groundnut in India is rainfed and relies entirely on summer monsoon rainfall. An assessment on the impact of climatic variability on groundnut would provide basic information required for evaluating climatic potential of the region. Moisture deficit index derived from annual precipitation and potential evapotranspiration was used as a tool for identifying the climatic types in impact analysis on groundnut productivity in middle Gujarat. Majority of the years fell in the semi-arid category and the pod yields decreased with transition from humid to arid climatic conditions. Highly significant association (at 1%) was noticed between rainfall during 38thand 39th standard meteorological weeks and groundnut pod yield. Minimum temperature during early stages of pod filling (September 15th to 30th) was observed to significantly (at 5%) influence the groundnut yields. This study clearly depicts

the influence of temporal variation in rainfall and temperature on the productivity of groundnut at Anand.

Adhikari R. N., et.al. (2012) considers that rainwater is the key input in dryland agriculture. As per authors the success to dryland agriculture lies in the efficient use of natural resources, particularly rainwater management. In a tropical country such as India which experiences more variation on rainfall, both in space and time, rain water management assumes vital importance in cutting down risks and optimizing crop production in dryland. Climate and soil are the two dominant factors in deciding whether or not runoff farming / water harvesting system will be possible and sensible. The hyper arid zone (P/PET < 0.03) is too dry for viable runoff farming, while sub humid zone (P/PET = 0.5 – 0.75) will be too wet. The runoff farming zone is primarily situated in the arid zone (P/PET= 0.03-0.2) and to some extent in the semi arid zone (P/PET = 0.2 – 0.5). Bellary region is characterized as one of the semi-arid zones of Karnataka bearing only 500 mm of average annual rainfall, confined in 35 rainy days having potential of runoff producing rain storms (5-7 days.) The study shows that the region experienced 13 meteorological droughts in the past 50 years in terms of annual rainfall. The region receives rainfall mostly from northeast monsoon and the crops are grown with conserved moisture during post rainy season (September - November). The seasonal rainfall analysis indicates the occurrence of agricultural droughts in 25 years in the past 50 years, which include 11 severe droughts. The average rainfall distribution shows that there is total failure in kharif season. However, some assured rainfall received during September and October has better prospect

for rabi season. An attempt is made in this paper to analyze probability of rainfall, drought studies on various parameters and water budgeting studies etc. for designing of water harvesting system and crop planning. The findings of this study will help to plan the watershed management project in this region and similar agro climatic regions of Karnataka and AP.

Gopinath K.A., et. al. (2012) conducted on-farm trials during 2010 and 2011 to evaluate the effect of different interventions on productivity and profitability of rainfed farming systems of small and marginal farmers in Y. Kothapalli, Anantapur district. There was a complete failure of intercropped pigeonpea in both the years due to drought. On an average, groundnut pod yield under farmers' practice was 194 kg ha-1. The increase in groundnut yields due to different interventions was 21% with herbicide use and 51% with use of recommended NPK. The yield increased by 155% with use of both herbicide for weed control and recommended NPK compared with farmers' practice. However, the net returns from groundnut + pigeonpea intercropping system were negative in all the treatments (-190 to -8,800 ha-1) due to complete failure of pigeonpea and poor groundnut yields in both the years. Among the farming systems of marginal farmers, integrated farming system involving crop production (groundnut + pigeonpea intercropping) and rearing of small ruminants (90 sheep and 30 goats) was found better with a net return of ' 1,57,855 year-1 compared to other farming systems. Similarly, among the three farming systems of small farmers, integrated farming system involving crop production (groundnut + pigeonpea intercropping) and livestock rearing

(2 desi cows and 100 sheep) gave higher net returns (1,09,650 year-1) compared to other farming systems.

Veeramani P. et.al. (2012) in their study made an attempt to study the possibility of more effective utilization of nutrients in divided dosages like basal and top dressing. The study carried out to have better understanding on optimizing the nutrient requirement and uptake in increasing the pod yield of groundnut and benefits of interactions between the organic and inorganic fertilizers. In this paper, the available literature on organic manure management practices *viz*., application of organic manure, bio-fertilizers and foliar nutrient spray in groundnut and their interactive effects on crop growth and yield are reviewed.

Mukhtar, A.A., et.al. (2013) conducted three irrigated trials during the dry season for three consecutive years at the Irrigation Research Station of the Institute for Agricultural Research, Ahmadu Bello University at Kadawa to study the growth and development of three groundnut (*Arachis hypogaea* L.) varieties as affected by plant population and basin size. The treatments, which consisted of three basin sizes (3m x 3m, 3m x 4m and 3m x 5m), three plant populations (50,000, 100,000 and 200,000 plants ha-1) and three varieties (Samnut 23, Samnut 21 and Samnut 11) were laid out in a split plot design with plant population and variety assigned to the main plots and basin sizes in the sub plots. Significantly tallest groundnut plants were observed when the crop was planted at 200,000 plants ha-1 while canopy spread was widest at 50,000 plants ha-1. Total dry matter was significantly highest at 100,000 plants ha-1. Plant population did not significantly affect number of

branches and number of leaves plant-1. Flowering was delayed at 50,000 plants ha-. Although Samnut 23 grew significantly taller than Samnut 21 and Samnut 11, Samnut 21 had wider canopy spread than Samnut 23 and Samnut 11. Plant height, canopy spread, number of leaves and branches, total dry matter (TDM) and days to 50% flowering were unaffected by basin sizes used.

Sreedevi Shankar K. and Nirmala G. (2013) conducted a baseline survey through a structured pretested questionnaire to assess nutritional status of women in all the four districts. Anthropometric data and dietary food intake of rural and tribal women was collected in Rangareddy, Medak, Nalgonda and Mahaboobnagar districts of Andhra Pradesh. As per the study about 60% of women were found to be in normal nutritional status in non-millet consuming households and 90% of women were found to be in normal nutritional status without any symptoms of malnutrition in millet consuming households of Rangareddy district. The extent of deficit in mean intake of different food groups was found to be higher (77-83%) for milk and milk products, for green leafy vegetables it was 25-67% and the intake of other vegetables was about 33-41%. In Nalgonda district, the comparison of mean weights of tribal girls of millet consuming households in the age group of 7-9 and 10-12 yrs showed better body weights compared to girls of non-millet consuming households in the same age group. Medak district data showed that 60% of rural women population was found to be in normal nutritional status who consumed millets in their daily diets. Women suffering from grade III malnutrition were found to be 14% in this district. The nutritional status of rural women of Farooqnagar mandal, Mahaboobngar district showed that 87%

of rural women population was found to be in normal nutritional status, and only 9 and 4% of women were found to be in grade I and grade III of malnutrition who consumed millets in their daily diets. In conclusion, the nutritional status of rural and tribal women and children in rainfed districts was found to be better with consumption of millet foods (sorghum).

Madhusudhana B., (2013) carried out a survey to discuss the ground nut area, production and productivity in India, Andhra Pradesh State and Ananthapuramu district. It analyzed the area, production and productivity of groundnut crop at national level, state level and district level during 1996-2000 to 2001-2008. The author made a comparative analysis of groundnut production in A.P and in Ananthapuramu district during 1996-2000 to 2001-2006. The groundnut crop area, production and productivity at national level, state level and Ananthapuramu district level of during 1996-2000 to 2001-2006 were collected and presented graphically. Based on the results collected some conclusions are made about the improving the production of groundnut crop.

Ramachandrappa B.K., et.al. (2014) considers that the soils in rainfed areas are poor in nutrients and low in organic matter as a result of continuous application of inorganic fertilizers. In order to sustain crop productivity, important nutrient management strategies have been studied at Dryland Agriculture Project, Gandhi Krishi Vigyan Kendra, Bangalore since 1978. The study found that in soil with high phosphorus status, balanced nutrition through application of nitrogen (50 kg/ha), potassium (25 kg/ha), calcium (lime @ 300 kg/ha), magnesium (MgCO3 @ 150 kg/ha) and boron (Borax @ 10 kg/ha) recorded higher finger millet grain yield of 3706 kg/ha. The soil

available nitrogen and potassium is low and phosphorus is medium, SSNM for a targeted finger millet yield of 4000 kg/ha with the application of 155:45:203 kg N, PO/ha could achieve the yield of 3971 kg/ha during 2008-09. Application of 150% of recommended potassium (37.5 kg/ha) along with recommended N and P (50 and 40 kg/ha) improved the yield of finger millet on potassium deficient Alfisols. Soil application of ZnSO4 @ 12.5 kg/ha and borax @ 10 kg/ha along with recommended NPK (seed treatment with molybdenum @ 2 g/kg of seed in pulses) increased yield of finger millet and pulses in soils deficit in zinc and boron. Soil application of borax @ 10 kg/ha and ZnSO4 @ 5 kg/ha coupled with foliar spray of ZnSO4 @ 0.5% and boron @ 0.25% at flowering stage improved the yield of groundnut. In-situ incorporation of horsegram at 8-10 weeks improved the soil fertility apart from increasing grain yield in the succeeding finger millet crop, with a saving of 50% recommended N. Application of FYM and recommended NPK increased the yield of dryland crops like finger millet and groundnut. Finger millet rotation with groundnut further increased the yield of finger millet by 25%.

Ali A. et.al. (2014) conducted field experiments at the University of Agriculture Makurdi Research Farm in 2010 and 2011 cropping seasons, to assess the effect of bambara groundnut biomass on the growth and yield of maize. Five treatments which were replicated three times in a Randomized Complete Block Design consist of 0, 5, 10, 15 and 20 t ha^{-1} of the biomass incorporated into the soil as green manure. Early maturing maize variety (TZER-Y-SR) was planted two weeks later. The study shows that 20 t ha^{-1} of the biomass produced the tallest plants (190.67 cm) in 2010 cropping season

followed by 15 t ha^{-1} (161.33 cm). All the treatments produced yields that were significantly higher than the control. Ten t ha^{-1}‘of the biomass produced the highest grain yield (4.24 t ha^{-1}) in 2010 cropping season. In 2011, 15 t ha^{-1} of the biomass produced the tallest plants (192.87 cm) followed by 20 t ha^{-1} (184.40 cm). The highest grain yield of 15.35 t ha^{-1} was produced by 10 t ha^{-1} of the biomass. Ten t ha^{-1} bambara groundnuts biomass is recommended for maize production in the study area.

Lagoke S.T.O., et.al. (2014) conducted a field trials in 2007 and 2008 early and late wet seasons, respectively at the Federal University of Agriculture Abeokuta (070 20‘N, 30 23‘E) in the forest-savanna transition agroecological zone of South-western Nigeria. Five weed control treatments viz pre-emergence application of commercial formulation of metolachlor plus prometryne (Codal GoldR, 412 EC) at 1.6kg a.i/ha alone, 1.6kg a.i/ha followed by supplementary hoe weeding at 6 weeks after planting (WAP), 2.4kg a.i/ha, two hoe weedings at 3 and 6 WAP and a weedy check were assigned to the main plots while intercropping methods which included four combinations of groundnuts between rows of maize spaced at 50cm and 75cm, as well as sole crops of maize and groundnut constituted the sub-plot treatments. The study found that the intercropped groundnut significantly suppressed weed infestation compared with the sole crops of maize and groundnut. Weed infestation was consistently lower in maize planted at intrarow spacing of 75cm in mixture with three groundnut stands in the inter-row between two maize stands and maize planted at 50cm in similar mixture with two groundnut stands compared with the other cropping methods. In both years of

study, maximum cob and grain yields were obtained with sole maize spaced at 50cm within rows. Intercropped maize at 75cm produced grain yield comparable to the corresponding sole crop in both years. Intercropped groundnut in maize spaced at 50cm significantly reduced grain yield of maize in 2007 and non-significantly in 2008 compared to the corresponding sole crop. All the weed control methods evaluated resulted in significantly lower weed cover score than the weedy check.

Edje O. T. and E. K. Mavimbela (2014) conduct an experiment to study the effects of inter-row spacing on crop growth and seed yield. The experiment consisted of three inter-row spacings. These were 50, 75, and 100 cm between rows at the same plant density, 66,667 plants/ha. The corresponding intra-row spacings were 30, 20 and 15 cm, respectively. One bambara groundnut variety, UNISWA Red was used in a randomised complete block design and the treatments were replicated four times. All plots received 500 kg/ha of a compound fertiliser before planting. The authors collected the data which includes seedling emergence, ground cover, sequential growth analysis, agronomic traits using coins for the quantification of preferences, seed yield components and seed yield. The study shows that seedling emergence was highest at the widest inter-row spacing of 100 cm with an intra-row spacing of 15 cm. Ground cover was achieved in the 50-cm and the 75-cm inter-row spacing, but not at the 100-cm inter-row. This would indicate that considerable light was unutilized at the widest inter-row spacing of 100 cm. It was concluded that closer inter-rows had a higher ground cover and might have been more efficient in capturing light and in reducing erosion and suppressing weeds. The authors at last recommends that bambara

groundnuts be grown at 50 cm between rows and 30 cm within rows for optimum yield notwithstanding the problem of earthening up.

Ashish S. Raghtate and C. C. Handa (2014) describes about the design and fabrication of various components of groundnut Sheller machine. The authors made an attempt to understand the knowledge of design and fabrication mechanism of groundnut Sheller machine. The design is an environment friendly and uses simple mechanism properties such as shelling system, blowering mechanism and automation separating system etc.

Suresh Kumar et.al. (2015) in their study assessed the impact of watershed development on the energy efficiency in groundnut cultivation. The study reveals that the overall technical, pure technical and scale efficiency increased by 11, 3 and 12% over the pre-watershed scores due to watershed development. Estimated potential for saving input energy was 3608, 3223 and 2907 MJ ha–for marginal, small and large farmers respectively, in groundnut Pal S., and D. Mazumdar, “Forecasting groundnut production of India using nonlinear growth models”,

Ravichandra K., (2015) conducted a field experiment on groundnut for two kharif seasons during 2009 and 2010 at crop research farm of SHIATS, Allahabad to find out the effect of foliar spray of boron in combination of rhizobium inoculation on growth and yield of groundnut. Inoculation with rhizobium along with application of boron as foliar spray at flowering and pod formation stage had significant and positive effect on growth and yield of groundnut with increased plant height, number of branches, plant dry weight, number of pods/plant, 100 pod weight, seed index and pod yield. Excess

spray of boron foliar nutrition led to decrease in the above mentioned parameters.

Pal S., and D. Mazumdar (2015) in their paper makes critical study of groundnut production of India with a non-linear approach. The authors used different nonlinear growth models viz. Monomolecular, Logistic and Gompertz models have been employed for modeling of India's total groundnut production during the period 1950-51 to 2011-12. The parameters of these models were estimated using Gauss- Newton algorithm. The authors observed that Monomolecular and Logistic models performed better followed by Gompertz for this dataset based on various goodness of fit criteria viz. Coefficient of determination (R2), Mean absolute error (MAE), Root mean square Error (RMSE) and Mean absolute percentage error (MAPE). Finally, India's total groundnut production for 2014-15 to 2019-20 has been forecasted by using the Monomolecular and Logistic models.

Denis N'Dri Yao et.al. (2015) through their study shows that the Bambara groundnut seed of Ci12 landrace of Côte d'Ivoire is a good source of essential amino acid, n-6 fatty acids and minerals, mainly Fe. With a high yield even when grown on poor soils, the Bambara groundnuts landrace C12 has the potential to improve the nutritional status and could be regarded as a nutrient dense food. Moreover, a tailored fermentation process could be optimized in an attempt to reduce anti-nutrients and, in turn, to improve the bioavailability of minerals and the overall nutritional quality.

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