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# A Review of Farming System, Irrigation, Intercropping and Nitrogen Management in Maize

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**Abstract:** Crop cultivation is a technique to cultivate the land and grow the different crops for the welfare of mankind. Farming system refers to a group combination of enterprises in which the products and or the byproducts of one enterprise serve as the inputs for production of other enterprise. In this review we discuss different type of farming systems in maize and cropping system related to their highest inputs use efficiency in different climatic regions. Nitrogen management is very critical to each crop. Some crops are restoratives and others are exhaustive. In maize we apply N in 2 or 3 splits according to crop requirement. Water use efficiency increases through judicious use of water. We can increase water use efficiency by improving crop varieties, applying best methods of irrigation such as furrow irrigation etc. Intercropping with same species of crop can give best yield and will be more economics per unit area.

**Key words:** Maize · Farming System · Water Management · Nitrogen Management · Intercropping

## INTRODUCTION

Increasing population and consumption, lack of available land and other productive units, have extraordinary pressure on current agriculture and natural resources to meet the demand for increasing food [1]. Getting food security under durable system is a major challenge in the developing world and it is extremely important to reduce poverty [2]. To reject this challenge, the crop producer tried to eliminate certain sources such as chemical fertilizer and insecticide, which resulted in a decline in the environment already [3]. To meet the needs of future food security and sustainability, food production must be substantially increased, while the environmental impact of agriculture will decrease at the same time [4]. The crop cultivation system defines as a complexity of technological, land improvement and organizational measures linked to land use and its improvement and improvement of soil fertility [5]. A farming system is described as the population of individual farm system, which has a wide range of resource members, enterprise patterns, domestic economies and barriers and for that same development strategy and interference [6]. It will be appropriate depending on the scale of analysis, a farming system may join some dozen or many millions of households [7]. Nitrogen fertilizer is essential for the high rate of food production provided by modern agriculture. It contributes 20-80 billion profit per year for EU farmers [8]. Beside that irrigation has long played a key role in feeding the expanding world population and is expected to play a still greater role in the future. As supplies of good-quality irrigation water are expected to decrease in several regions due to increased municipal–industrial–agricultural competition, available freshwater supplies need to be used more efficiently. Water use for agricultural production requires modern and durable research and proper transfer of technology [9]. Intercropping, the simultaneous cultivation of multiple crop species in a single field, increases above ground productivity due to completing multiple crops of species. We believe that intercrop have high belowground productivity in comparison to single crops and as much as possible soil carbon and sequester more soil carbon over time due to greater input of root litter [10]. Which disorders can reduce the burden of buffering capacity, extreme weather effects, along with the spread of insects and disease as well as land and surface water and greenhouse gases

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emissions resulting in the loss of nutrients [11]. Organic agriculture based on the growing organic matter has been presented as a solution to the organic matter and recently meta-analysis shows that soil carbon is really growing under organic agriculture, mostly substantial additional results of organic matter [12, 13].

**Farming System in Maize:** Maize is cultivated all over the world, although there are huge gaps in yields. The Food and Agriculture Organization (FAO) of the United Nations predicts that agricultural production consisting commodities that are assumed as edible and contain nutrients and reflect the relative level of the aggregate volume of agricultural outputs for every year in relation with the base period 1999–2001 [14]. It is calculated that in 2012, the total world production of maize was 875, 226, 630 tons, 27 with the United States, China and Brazil harvesting 31%, 24% and 8% of the total yield of maize, respectively [15]. Food balance sheets showed by the FAO are commonly used as a data source for calculating patterns, levels and trends of national diets which are consuming and are referred to as the FAOSTAT food balance sheets, in reference to the database that collects the data [16]. The FAOSTAT food balance sheets indicate maize vacancy for human utilization, which interrelates to the sources of supply and its consumption. The total quantity of maize produced in a country added to the total quantity imported and adjusted to any change in stocks that may have occurred since the beginning of the reference period gives the supply available during that period [17]. On the utilization side, a distinction is made between the quantities of maize exported, fed to livestock and used for seed, losses during storage and transportation and supplies available for human consumption. The per capita supply of maize available for human consumption is then obtained by dividing the respective quantity by the related data on the population actually partaking in it Wortmann and Kaizzi [18]. Data on per capita maize supply are expressed with respect to quantity and by applying appropriate food composition factors for maize, including dietary energy value, protein and fat content [19].

Different kinds of maize are cultivated all over the world, with one significant difference being color. Maize kernels can be varies colors ranging from white to yellow to red to black. Commonly the maize grown in the United States is yellow, while people in Africa, Central America and the southern United States like white maize [20]. Yellow maize is not famous in Africa for reasons associated with the perception of social status: significantly it is connected with food-aid programs and is perceived as being used only by poor people. Also, the feed industry consumes mostly yellow maize in the manufacture of animal feed [21].

There is a classification of corn according to the size and composition of the endosperm. Resulting in an artificial definition by kernel type as follows: dent, flint, waxy, flour, sweet, pop, Indian and pod corn. There is another difference or standard rating is the sweetness or amount of sugar [22]. The amount of sugar remaining depends on the variety of corn and when harvested from the field. Yellow maize is badly fed and must be eaten fresh, canned or frozen before the nucleus age and becomes small, hard and corrosive. Sweet varieties cannot be categorized [23].

**Nitrogen Management in Maize:** Over the past several decades, the crop diversity of the North Corn belt (Ontario and North America) has decreased dramatically and only corn-based rotation is increasingly dominating the landscape [24]. Increases in the area of maize and soybeans coincided with reductions in cultivated areas of grasslands, feed and other small grains [25]. Many agricultural and environmental outcomes associated with crop diversity loss of rotation also affect soil nitrogen processes, N loss and crop response to N Yang *et al.* [26]. For example, there is ample evidence that the removal of legumes, such as alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.) or soyabean (*Glycine max* L.) Of maize (*Zea mays* L.) the rotation is based on increased N fertilization rates and has a significant impact on N dynamics [27].

The direct and indirect benefits of maize-wheat cropping system on soil properties have also improved the recovery of specific N fertilizers. More diverse rotations and improved soil structure, aggregation and health help to promote root growth, which in turn can improve the N fertilizers uptake [28]. Greater duration without tillage and abundant living plant roots in diverse rotations can also host *mycorrhizea* over a longer period of time within the crop rotation [29]. This can increase the services they provide such as increase available N uptake especially in water-stress environments [30]. For maize, the comparatively contributions of N uptake effciency and N consumption, or utilization, efficiency to overall NUE varies depending on a number of variables. Roberts [31] found that in maize N uptake efficiency was more closely correlated to NUE at high N and to N utilization, or usage, efficiency at low N.

**Intercropping in Maize:** Smallholder farmers practice cereal-legume intercropping to mitigate risks of crop failure in mono-cropping system [32]. The productivity of cereal-legume intercrops could be influenced by the spatial arrangement of the intercrops and the soil fertility status [33]. Maize is a substantial feeder of soil nitrogen [34]. Beans are legumes, which means they can increase soil nitrogen by biological nitrogen fixation from the air, named nitrogen fixation [35]. Smallholder farmers in Africa generally use maize/bean intercropping to expand soil nitrogen and agricultural efficiency [36]. One Acre Fund conducted a series of maize/legume intercropping trials in order determine the optimum species and arrangement to provide farmers with significant and positive economic and food security impacts [37]. Other studies generally showed intercrop advantages over sole crops that declined as the width of adjacent strips of each crop was increased [38]. For instance, [39] reported a larger LER for 1:1 alternate rows of maize and groundnut than for 2:2 alternate row intercrops. In some cases, sole crops were more productive than intercrops when two or more rows of intercropped maize were alternated with the same number of groundnut (*Arachis hypogaea* L.) rows.

**Irrigation Management in Maize:** Crop cultivation is often ineffective due to the low water use efficiency (WUE) rate in irrigation, which is calculated on the basis of the proportion of water used by the crop relative to the amount of water actually used during irrigation [40]. Corn is one of the most important grains in the world and its production must almost double to meet the increasing demand for food, biofuels and livestock feed, especially in developing countries [41]. In addition, climate change will likely affect water supply and water demand, heightening this problem in the future. Water use control methods and water resources planning are of high priority. In irrigated agriculture, the right way to save water is to increase water use efficiency through better management. The present work validates procedures and methodologies using remote sensing to determine the water availability in the soil at each moment, giving the opportunity for the application of the water depth strictly necessary to optimize crop growth (optimum irrigation timing and irrigation amount) [42]. However, achieving that increases goals will be difficult because of water scarcity, which is already a critical problem in numerous parts of the world and is expected to become more acute in the future [43]. While maize is grown widely from the south to the northern hemisphere, from arid and semi-arid regions to wet and sub-humid areas, water scarcity will increasingly limit maize production. In addition, climate change is likely to affect water supply and water demand, increasing this problem in the future [44]. The recent trend toward planting longer-maturing maize varieties in response to increased temperatures could increase the demand for water when the needed water is increasingly unavailable. The relationship between this increased demand for water and water availability in maize production in China and elsewhere has not been quantified. It was found that the gap between rain fed yields and irrigated yields substantially increased from 5% in the 1980s to 10% in the 2000s and that 40% of the maize production area in CMB now fails to receive the precipitation required to achieve full yield potential. Growing sensitivity of maize production to water scarcity resulting from a shift to longer-maturing varieties makes adaptation to climate change especially difficult and suggests that new adaptation measures are needed. These measures include new approaches to agronomic management and water management and the breeding of new varieties [45].

## CONCLUSION

From all above discussion, we can conclude that proper farming system can help us to enhance yield of our crop keeping in view all the suggestions of FAO and FAOSTAT. We can increase nitrogen availability by improving the soil structure, aggregation and health help to enhance the root growth, which can help in increasing the nitrogen uptake. Maize helps in nitrogen uptake. Intercropping with maize can help in the availability of Nitrogen. In conditions of water scarcity, irrigation must be scheduled for a maximum allowed depletion of 45% of the water available in the soil during the non-critical stages of growth of maize grown in sandy loam soils in subtropical regions to obtain the maximum yield of grains and on the dry matter of the soil, as well as the maximum efficiency of water use in the field and the net return.

## REFERENCES

1. Obi, I.U., 1991. Maize: Its agronomy, diseases, pests and food values optimal computer solutions limited, Enugu, pp: 208.
2. Adenola, O.A. and J.A. Akinwumi, 1993. Maize production constraints in Nigeria. Fakorede et al. editors) Maize Improvement, Production and utilization in Nigeria published by the maize association of Nigeria, pp: 223-232.

3. Oladipo, J.L., J.M. Fajemisin and O. Olanya, 1993. Disease of maize- Damage and control in Nigeria. Maize improvements, production and Utilization in Nigeria, pp: 1181-1188.
4. Olakojo, S.A. and J.O. Kogbe, 1999. Reaction of some maize Genotypes with infestation with Striga asiatica. Bioscience Research Communication, 131S-139S.
5. Lale, N.E.S., 1993. A laboratory assessment of the effectiveness of four storage devices and Capsicum frutescens in the abatement of infestation of stored cowpeas by Callosobruchus maculates (coleoptera: Bruchidae). Revue de Zoologie Africaine, 107: 39-43.
6. Omueti, O., 1999. Home level preparation of protein improved kokoro (soya-kokoro maize snack). Tropical oil Seeds Journal, 4: 95-101.
7. Olakojo, S.A., J.O.S. Kogbe, V. Olajide and A. Doh Nell, 2001. Host-Parasite relationship of Striga asiantica and maize (Zea mays) under varied moisture levels and Nitrogen source. Nigeria Journal of Weed Science, 14: 41-46.
8. Lale, N.E.S., 1992. Oviposition-deterrent and repellent effects of products from dry chili pepper fruits, Capsicum species of Callosobruchus maculatus. Post-harvest Biology and Technology, 1: 343-348.
9. Adenle, V.O. and K.F. Cardwell, 1999. A new strain of downy mildew pathogen of Maize: A challenge to Geneticists/ breeders Genetics in food security in Nigeria, pp: 54-55.
10. Alika, J.E. and M.E. Aken'ova, 1986. Preliminary investigation into the variation between local maize (Zea mays L.) germplasm of Bendel State of Nigeria. Proc. Of Nationwide Conference on Maize Research, Production and Utilization in Nigeria, Progress and Problems. Univ. of Ife, Ile-Ife Nigeria. March, 17-21.
11. Lale, N.E.S., 1994. Laboratory assesment of the effectiveness and persistence of the powder of four spices on bruchuid and maize in air-tight storage facilities. Samaru Journal of Agricultural Research, 11: 79-84.
12. Ashaye, O.A., S.B. Fasoyiro and R.O. Kehinde, 2000. Effects of processing on the chemical and Sensory Quality of Ogi Fortified with Full Fat Cowpea Flour. Moor Journal of Agricultural Research, 1: 115-123.
13. Daramola, A.M., 1985a. Comparative effectiveness of Carbofuran and Carbaryl for the control of maize stem borers. Niger. J. Plant Protect, 9: 54-59.
14. Voortman, R.L., B. Sonneveld and M. Keyzer, 2000. African Land Ecology: Opportunities and Constraints for Agricultural Development. Harvard University Center for International Development (CID) Working Paper no.37.
15. Woelcke, J., T. Berger and S. Park, 2002. Land management and technology adoption in Uganda: An integrated bio-economic modeling approach, In: Nkonya, E., Sserunkuuma, D., Pender, J. (Eds). Policies for Improved Land Management in Uganda: Second National Workshop. EPTD Workshop Summary Paper No. 12, 131-136.
16. Wood, S., K. Sebastian, F. Nachtergaele, D. Nielsen and A. Dai, 1999. Spatial aspects of the design and targeting of agricultural development strategies. International Food Policy Research Institute (IFPRI). Environment and Production Technology Division (EPTD). Discussion paper # 44.
17. Woomer, P.L., M.A. Bekunda, N.K. Karanja, T. Moorehouse and J.R. Okalebo, 1998. Agricultural resource management by smallholder farmers in East Africa. Nature and Resources, 34(4): 22-33.
18. Wortmann, C.S. and C.K. Kaizzi, 1998. Nutrient balances and expected effects of alternative practices in farming systems of Uganda. Agriculture, Ecosystems and Environment, 71: 115-129.
19. Young, A., 1997. Agroforestry for soil management, second ed. International Center for Research in Agroforestry (ICRAF) and CAB International, pp: 53-89.
20. Zake, J.Y., M.K. Magunda and C. Nkwiine, 1997. Integrated soil management for sustainable agriculture and food security. The Ugandan case. In: Paper Presented at the FAO Workshop on Integrated Soil Management for Sustainable Agriculture and Food Security in Southern and Eastern Africa, Harare, Zimbabwe Dec. 8-12, 1997.
21. Angelsen, A., 1999. Agricultural expansion and deforestation: Modeling the impact of population, market forces and property rights. Journal of Development Economics, 58(1): 185-218.
22. Barrett, C.B., 1996. On price risk and the inverse farm size-productivity relationship. Journal of Development Economics, 51: 193-215.
23. Barrett, C.B., T. Reardon and T. Webb, 2001. Non-income diversification and household livelihood strategies in rural Africa: Concepts, dynamics and policy implications. Food Policy, 26(4): 315-331.
24. Timsina, J., M.L. Jat and K. Majumdar, 2010. Rice-maize systems of South Asia: Current status, future prospects and research priorities for nutrient management. Plant Soil, 335:65–82. doi:10.1007/ s11104-010-0418-y

25. Van Groenigen, J.W., G.L. Velthof, O. Onema, K.J. Van Groenigen and C. Van Kessel, 2010. Towards an agronomic assessment of N2O emissions: A case study for arable crops. Eur. J. Soil Sci., 61: 903-913. doi:10.1111/j.1365-2389.2009.01217.x
26. Yang, H.S., A. Dobermann, J.L. Lindquist, D.T. Walters, T.J. Arkebauer and K.G. Cassman, 2004. Hybrid-maize: A maize simulation model that combines two crop modeling approaches. Field Crops Res., 87: 131-154. doi:10.1016/j.fcr.2003.10.003.
27. Yang, H.S. and B.H. Janssen, 2000. A mono-component model of carbon mineralization with a dynamic rate constant. Eur. J. Soil Sci., 51: 517-529. doi:10.1046/j.1365-2389.2000.00319.x
28. Moebius-Clune, B., H. Van Es and J. Melkonian, 2009. Adapt-N: An adaptive nitrogen management tool for corn production. Cornell Univ., Ithaca, NY. Novoa, R. and R.S. Loomis. 1981. Nitrogen and plant production. Plant Soil, 58: 177-204. doi:10.1007/BF02180053.
29. Olfs, H.W., K. Blankenau, F. Brentrup, J. Jasper, A. Link and J. Lammel, 2005. Soil- and plant-based nitrogen-fertilizer recommendations in arable farming. J. Plant Nutr. Soil Sci, 168: 414-431. doi:10.1002/jpln.200520526.
30. Ping, J.L., R. Ferguson and A. Dobermann, 2008. Site-specifi c nitrogen and plant density management in irrigated maize. Agron. J., 100: 1193-1204. doi:10.2134/agronj2007.0174.
31. Roberts, D., 2009. An integrated crop- and soil-based strategy for variable-rate nitrogen management in corn. Ph.D. diss. Univ. of Nebraska, Lincoln (Diss. Abstr. 3360163).
32. Awal, M.A., H. Koshi and T. Ikeda, 2006. Radiation interception and use by maize/peanut intercrop canopy. Agric. For. Meteorol, 139: 74-83.
33. Buri, M.M., R.N. Iassaka, H. Fukii and T. Wakatsuki, 2010. Comparison of soil nutrient status of some rice growing environments in the major agro-ecological zones of Ghana. J. Food Agric. Environ, 8: 384-388.
34. Chang, J.F. and R.M. Shibles, 1985. An analysis of competition between intercropped cowpea and maize: i Soil N and P levels and their relationships with dry matter and seed productivity. Field Crop Res., 12 133-143.
35. Dakora, F.D., R.A. Aboyinga, Y. Mahamah and J. Apaseku, 1987. Assessment of N2 fixation in groundnut (*Arachis hypogaea* L.) and cowpea (*Vigna unguiculata* L. Walp) and their relative N contribution to a succeeding maize crop in northern Ghana MIRCEN. J. Appl. Microbiol. Biotechnol., 3: 389-399.
36. Franke, A.C., E.D. Berkhout, E.N.O. Iwuafor, G. Nziguheba, G. Dercon, I. Vandeplas and J. Diels, 2010. Does crop-livestock integration lead to improved crop production in the savannah of West Africa? Expl. Agric, 46: 439-455.
37. Gallo, K.P. and C.S.T. Daughtry, 1986. Techniques for measuring intercepted and absorbed photosynthetically active radiation in corn canopies. Agron. J., 78: 752-756.
38. Gao, Y., A. Duan, X. Qiu, J. Sun, J. Zhang, H. Liu and H. Wang, 2010. Distribution and use efficiency of photosynthetically active radiation in strip intercropping of maize and soybean. Agron. J., 102: 1149-1157.
39. Giller, K.E., 2001. Nitrogen Fixation in Tropical Cropping Systems. CABI Publishing, Wallingford. Gimenez, C., Connor, D.J., Rueda, E., 1994. Canopy development: photosynthesis and radiation use efficiency in sunflower in response to nitrogen. Field Crop Res., 38: 15-27.
40. Kashyap, P.S. and R.K. Panda, 2001. Evaluation of evapotranspiration estimation methods and development of crop-coefficients for potato crop in a sub-humid region. Agric. Water Manage, 50(1): 9-25.
41. Kumar, R. and S.K. Pathak, 1989. Optimal crop planning for a region in India by conjunctive use of surface and ground water. Int. J. Water Resources Develop, 5(2): 99-105.
42. Martin, D.L., E.C. Stegman and E. Freres, 1990. Irrigation scheduling principals. In: Hoffman, G.L., Howell, T.A., Solomon, K.H. (Eds.), Management of Farm Irrigation Systems. ASAE Monograph, pp: 155-372.
43. Nouna, B.B., N. Katerji and M. Mastrorilli, 2000. Using the CERES-Maize Model in a semi-arid Mediterranean environment. Evaluation of model Performance. Euro. J. Agron, 13(4): 309-322.
44. Otegui, M.E., F.H. Andrade and E.E. Suero, 1995. Growth, water use and kernel abortion of maize subjected to drought at silking. Field Crops Res., 40(2): 87-94.
45. Jefferies, E.C., J.E. Hook and S.L. Blair, 1992. Using crop models to plan water withdrawal for irrigation in drought years. Agric. Sys, 45(3): 271-289.