Review Article

Customized Fertilizer: A Key for Enhanced Crop Production

Abstract

One of the most important inputs in increasing food grain production is fertiliser. In terms of nutrients (N, P, and K), annual fertiliser consumption has increased from 0.07 million tonnes in 1951–1952 to more than 26.5 million tonnes in 2017–2018 (FAI, 2018), and consumption per hectare has increased from less than one kilogramme in 1951–1952 to the level of 137.62 kilogrammes in 2015–16. An important component for crop yield and productivity is fertiliser. Fertiliser use accounts for 55% of increased food output. India's annual food grain requirement is around 300 mt per annum by 2020. The area under cultivation cannot be expected to grow beyond the current 142 mha, hence a large portion of the increase in food grain output must be achieved by increasing productivity per unit area. In comparison to most crops, rice has a nitrogen fertiliser efficiency of just 30–40% and other cereals have a phosphorus fertiliser efficiency of 15–20%. . Combinations of primary nutrients, secondary nutrients, and micronutrients may be included in the customised fertiliser. At customised fertilisers, major ingredients like Urea, Diammonium Phosphate (DAP), and Potash are combined with micronutrients like sulphur, zinc, and boron in a ratio that is appropriate for certain crops and soil types.As we know that, in addition to bigger amounts of fertilizer being removed, the development of high yielding systems is likely to make the problem of secondary and micronutrient deficiencies worse by applying huge amounts of N, P, and K to meet higher yield targets. As a result, there is a chance that in intensive systems, a negative balance may develop and there will be a shortage of secondary and micronutrients. Balanced fertilisation, site-specific nutrient management, and customised fertilisers will all be crucial in achieving sustainable future goals. In long run, such a strategy may also increase agricultural yields and prevent the loss of soil fertility. As a result, the current article concentrates on the various features of customised fertilisers connected to their necessity, production, standards, and long-term prospects.

Keywords: Fertilizers, Yield, Fertilizer use efficiency, Productivity and Nutrition.

Introduction:

It is crucial to expand food production in order to meet the 1.4 billion predicted people's need for food grains, with an expected annual population growth rate of 1.1% by the year 2025. India's need for food grains is anticipated to reach around 300 million tonnes annually by 2025 (FAI, 2018). The area under cultivation cannot be expected to expand beyond the current 142 mha, hence a large portion of the increase in food grain production must be achieved by increasing productivity per unit area. The enhanced food production supported by mineral fertilisers has kept roughly half of the world's population alive today. Only fertilisers account for 55% of additional food grain production (Kaleeswari, 2013). In terms of nutrients (N, P, and K), annual fertiliser consumption has increased from 0.07 million tonnes in 1951–1952 to more than 26.5 million tonnes in 2017–2018 (FAI, 2018), and consumption per hectare has increased from less than 1 kilogramme in 1951–1952 to the level of 137.62 kgs in 2015–16. (DoF, 2012).The average but partial factor productivity of fertilisers, however, has been declining over time. The nutrient use efficiency of phosphorus is 15-20% in most crops, whereas the efficiency of nitrogen is only 30-40% in rice and 50-60% in other cereals. The efficiency of K is 60-80%, while that for S is 8-12%. In case of micronutirents, the efficiency is below 5% (Rakshit, 2002).Customized fertilisers are distinct, ready-to-use granular fertilisers that are developed using strong scientific plant nutrition principles in conjunction with knowledge of the soil, comprehensive laboratory testing, and field evaluation. According to the FCO, customised fertilisers are important and are defined as: Multinutrient carriers made using a systematic granulation process that are suited to the site, soil, and stage of the crop and contain macro, secondary, and/or micronutrients from both inorganic and/or organic sources and capability developed by an accredited fertiliser manufacturing/marketing company (Rakshit *et al*., 2012). The prevalence of several nutrient deficits in soils is causing a steady decline in partial factor productivity. All of these are brought on by the uneven use of chemical fertilisers and the reduced use of organic manure, which together result in low fertiliser use efficiency. Given that between 40 and 50 percent of nitrogen applied as fertiliser is lost through ammonia volatilization, leaching, runoff, and denitrification, it is necessary to encourage the development of more effective nitrogen fertilisers, such as neem-coated urea, by offering price incentives to fertiliser manufacturers. However, the majority of the current line of fertiliser products dates back more than 40 years. No "new" effective fertiliser product has been created in the previous 25 years, especially one

that is cost-effective enough for farmers in developing nations to utilise on their food crops. To feed the world's expanding population, guarantee sustainable global food security, and safeguard the environment, new and improved fertilisers are essential. The main conclusions arising from the discussion above are that new and improved fertilisers, i.e., customised fertilisers based on soil-test-crop response research, are desperately needed for key cropping and farming systems in various agro-eco regions of the country.

Concept of customized fertilizer:

More than just a fertiliser, customised fertiliser is a philosophy centred on plant nutrition. These fertilisers are supported by reliable scientific plant nutrition research. The term "customised fertiliser" refers to a multi-nutrient carrier that contains macro and/or micronutrients, whose sources are from inorganic or organic, that is produced through a systemic granulation process, and that satisfies crop nutritional demand, specific to area, soil, and stage of plant growth. Customized Fertilizers are produced using a systemic granulation method with strict quality controls. They are enhanced with macro and micronutrients.

The goal of the customised fertiliser is to offer site-specific nutrient management in order to achieve the highest possible fertiliser use efficiency for the given nutrient in a financially viable way in order to create customised fertilisers that are suitable for particular crops and soil types, major ingredients like Urea, Diammonium phosphate (DAP), and Potash are combined with micronutrients like sulphur, zinc, and boron. The customized fertiliser is made to include nutrients (both macro and micro) in forms, amounts, and proportions that are very unique to the place and crop. In other words, customised fertilisers are nutrient carriers that are precisely crafted to satisfy a crop's unique nutritional requirements. Since all granules of fertiliser are produced using high-quality technology, their physical form and chemical content are exceedingly homogeneous. To acquire the correct percentage of N, P, K, S, and micronutrients, urea, DAP, MOP, ZnS, bentonite sulphur, and boron granules are mixed and crushed to create customised fertiliser. To produce a consistent product with every grain having the same nutrient composition, the mixture is put through a series of processes including steam injection, drying, sifting, and cooling. The urgent need for additional research to increase fertiliser use efficiency is highlighted by the dramatic increase in fertiliser prices. Corporate social to keep assisting farmers in India to increase yields while using less fertiliser, for example, by using Integrated Soil Fertility Management (ISFM)i.e

compost, FYM etc. as a tool to boost fertiliser effectiveness for improved profitability of small holder farmers in India (Rakshit *et al.*, 2012).

Objectives of Customized Fertilizer

Customized fertilizer's primary goal is to encourage site-specific nutrient management in order to obtain the highest possible fertiliser use efficiency of applied nutrients in a practical manner. Based on soil tests and crop requirements, the customised fertiliser may contain a combination of primary, secondary, and micronutrients in its formulation. It might also comprise specially formulated combination products that are 100% water soluble. It is anticipated that potential manufacturers or distributors will employ software tools like Decision Support System for Agro Technology Transfer (DSSAT). Crop Model, etc., to determine the ideal fertiliser grade combinations.

Role of customized fertilizers in Site Specific Nutrient Management (SSNM)

For food crops, current fertiliser recommendations often consist of "blanket" recommendations with predetermined rates and timings for wide tracts. When broad-based blanket fertiliser recommendations are employed, the efficiency of fertiliser application is restricted by the considerable field-to-field variability of soil nitrogen supply. Site-Specific Nutrient Management (SSNM) ensures that nutrients are applied in accordance with the needs of the crop in a particular field while maintaining the soil's health at the same time (Majumdar and Prakash, 2018). The fertiliser industry supports SSNM by creating customised fertilisers. These are being improved over time. SSNM offers advice pertinent to the arrangement of farmers' fields. Crop yields are preserved and improved through SSNM, which also saves farmers money by using fertiliser more effectively. In some circumstances, greenhouse gas emissions can be minimised by up to 50% by reducing the overuse of fertilisers. The cost of fertiliser has a significant impact on SSNM adoption. Fertilizer costs should be reduced, and the availability of customised fertilisers should be raised so that these fertilisers would be better used as a part of SSNM in every farmer's field (Singh *et al.*, 2014).

Customized Fertilizer Formulations

With a better blend comes a better yield. The Fertilizer Association of India (FAI, 2019) is recommending exact standards for a certain grade of formulation for based application.The formulation should be granular in size with at least 90% of the materials remaining between 1-4 mm in accordance with Indian standard sieve. Also, size smaller than 1 mm should not exceed 5%, and the product should not be more than 1.5%.Foliar application grades must

contain at least 30 units of all the combined nutrients and must be completely water soluble. The method computes a formula with the most cost-effective combination of the available ingredients and an application rate that has been reduced to cost per acre. For all nutrients, the tolerance limit shouldn't be higher than 3%, especially when secondary and micronutrients are also present in addition to NPK. These formulations, such as 8:16:24:6:0.5:0.15, made by Tata Chemical Limited and intended for potatoes cultivated in the Uttar Pradesh districts of Agra, Aligarh, and Farrukhabad, are an example (U.P). A different recipe, 10:13:12:6:2:0, was created especially for the sweet sorghum grown in Nanded, Maharashtra. The approval for two customised formulations, 15:15:15:9:0.5:0.2 and 20:0:15:0:0:0.2, intended for groundnut in Anantapur and maize in Warangal districts of Andhra Pradesh, has also been given to Coromandel Industries Limited (A.P). About 36 different customised fertiliser formulations have been certified by the Fertilizer Control Order (FCO) (Vidyashree and Arthanari, 2021).

Advantages of Customized Fertilizers

1. Promoting site-specific nutrient management is the main goal.

2. Customized fertiliser is the greatest choice for managing fertilisers in a way that maximises agricultural production while minimising negative effects on the environment and human health.
3. Customized fertilisers will address the issue of poor fertiliser use efficiency and provide a new virtual source of nutrients assuming from the current availability and consumption of DAP, MOP, Urea, SSP, and AS in India. Instantaneously more agricultural produce will be produced because of improved fertiliser distribution and availability. Maintaining the same subsidy allocation makes all of this possible.
4. A customised fertiliser meets the nutritional needs of the crop, taking into account the region, the soil and balanced growth stage of plant.The addition of micronutrients to the granulated NPK fertiliser allows plants to absorb both macronutrients and micronutrients simultaneously, preventing nutritional deficit in plants. The total cost is decreased because the farmer won't have to pay extra to buy each micronutrient separately. This is due to the contact between the micronutrient and the mixed fertiliser (Amarnath*et al*., 2016).
5. Farmers often apply fertiliser without knowing the crop needs, however in this case, fertiliser use efficiency can be maximised in a cost-effective way.

6. It provides nutrients that are readily available to plants in sufficient quantities and in the right proportions.This produces a balanced application because it offers not only primary nutrients but also secondary and micronutrients. Additionally, the composition's special features guarantee that nutrients are distributed uniformly.It can be used for fertigation because it is completely water soluble. Therefore, it is significant in the high-tech farming system. It can boost the nutrient use efficiency.
7. Customized fertiliser is a soil-crop-climate-based fertiliser that is less impacted by soil, plant, and climatic conditions, resulting in more nutrient uptake and decreased nutrient loss.
8. Customized fertiliser lowers fertiliser application costs, which in turn lowers cost of cultivation.
9. Site- and crop-specific fertilisers can be developed to enhance soil health.

Customized fertiliser is unquestionably a market in the fertiliser revolution that might widen the application of site-specific nutrient management and precision farming. Based on soil testing and crop needs, the formulation of the customised fertiliser may contain a combination of primary, secondary, and micronutrients.It is time to offer incentives to farmers who use 100% water soluble fertilisers in order to promote the concept. Customized fertilisers adapted to agro-climatic conditions can be offered to farmers in order to address nutrient deficiencies, especially those in secondary and micronutrients.

Customized Fertilizers and Opportunity

Customized fertilisers can launch a major push to address the concurrent concerns of maintaining food and nutritional security. Customized fertiliser offers marketing and agronomic opportunities.

1. Effect of customized fertilizer on growth and yield parameters of crops: Customized fertilisers surpassed farmer practises or the traditional dose of recommended fertiliser in terms of growth and yield characteristics like plant height, effective tillers, spike length, spike weight, number of grains per spike, 1000-grain weight, grain yield, and straw yield. This is because these characteristics automatically increased net returns and B:C ratio.Mudalagiriyappa*et al.,* (2015) found an increase in plant height, number of tillers(i.e growth parameters)with increment in dose of customized fertilizer application at harvest (Table 1). The increase in plant height brought on by the application of customised fertiliser may be linked to the crop's optimal growth and nutrition. Also, the extra nutrients offered by

a higher dose of customised fertiliser results in the formation of enhanced tiller production with increased fertiliser. The highest grain and straw yields, of 3279 and 4510 kg/ha, were observed in plots that received 150% customised fertiliser dose (Table 2). Due to balanced nutrition, enhanced vegetative development, and growth indices including total dry matter production and a rise in the number of tillers, which resulted in the largest grain yield, the crop did not experience nutrient stress at any stage of growth.

Kambleand Kathmale (2015) showed thatcustomized fertilizer application in split doses in onions were shown to be significant with an increase of 30.1% in green leaf production, plant height grew by 10 cm, stem diameter by 1.4 cm, and bulb diameter by 4.21 cm along with a 37.7% increase in the total yield of onion bulbs (As given in Table 3).The increase in plant height, stem diameter, and bulb diameter observed with the addition of NPK through CF may be attributed to a greater availability of nutrients, particularly N, which increases the number of leaves by its simulative effect on cell division and cell enlargement that in turn may increase the number of leaves and leaf dimensions.The improvement in vegetative growth, rise in net assimilation rate, and acceleration of photosynthates in storage organs of bulbs could all be contributing factors to the increase in yield. The application of the full recommended dose of fertiliser (100:50:50 N: P2O5:K20 kg ha-1) in two or three splits through CF to onions boosted net financial returns in addition to soil fertility, bulb output, and yield-contributing features.

Table 1. Effect of various levels of customized fertilizers on growth and yield parameters of finger millet

Treatments	Plant height (cm)			No. of tillers/hill			No. of ears per hill at harvest			Test weight (g)		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean

T1: Absolute Control	62	54	58	2.00	2.93	2.46	3.03	2.20	2.61	3.10	2.90	3.00
T2: 50% CF (20:17:11:3:0.4 % N-P-K-S-Zn)	82	66	74	3.53	4.07	3.80	4.27	3.20	3.73	3.30	3.06	3.18
T3: 75% CF	93	77	85	4.63	4.87	4.75	5.29	4.07	4.68	3.47	3.32	3.39
T4: 100% CF @ 375.0 kg/ha	95	87	91	6.77	5.67	6.22	6.64	4.80	5.72	3.62	3.47	3.54
T5: 125% CF	108	90	99	7.47	6.00	6.73	6.83	5.00	5.91	3.70	3.52	3.61
T6: 150% CF	112	93	102.5	7.83	6.40	7.11	7.16	5.27	6.21	3.75	3.55	3.65
T7: RDF (50:40:25 kg/ha N-P-K)	79	65	72	4.37	4.13	4.25	4.44	3.47	3.95	3.33	3.13	3.23
CD (P=0.05)	11.00	8.23		1.10	0.79		0.81	0.69		0.13	0.10	

Dwivedi*et al.* (2019) also reported that use of 150% of customized fertiliser greatly increased plant height, pod number, pod weight, and grain production per pod.It also resulted in higher grain yield,stover yield which leads to high B:C ratio and net returns (Table 4). This is mainly because the application of a single nutrient is less advantageous than mixing several nutrients together in the proper ratio, which increases growth parameters and yield.

Table 2. Effect of various levels of customized fertilizers on yield and economics of finger millet

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)			Net returns (₹/ha)			B:C ratio		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
T1: Absolute Control	788	825	806.5	985	1469	1227	1794	2776	2285	1.21	1.32	1.26
T2: 50% CF (20:17:11:3:0.4 % N-P-K-S-Zn)	2065	2195	2130	2582	3432	3007	11941	14429	13185	1.80	1.95	1.87
T3: 75% CF	2595	2682	2639	3244	4196	3720	17680	19929	18804.5	2.10	2.22	2.16
T4: 100% CF @ 375.0 kg/ha	3022	3040	3031	3778	4719	4249	22082	23571	22826.5	2.28	2.35	2.32
T5: 125% CF	3221	3233	3227	4026	4849	4438	26520	24750	25635	2.72	2.33	2.53
T6: 150% CF	3250	3307	3279	4062	4957	4510	26052	24258	25155	2.33	2.23	2.28
T7: RDF (50:40:25 kg/ha N-P-K)	2025	2250	2138	2531	3672	3102	10692	14785	12738.5	1.68	1.93	1.81
CD (P=0.05)	384	349		480	384.72							

Table 3. Effect of different levels of customized fertilizer on yield and yield contributing characters of onion at harvest

Treatments	Height of plant (cm)	Stem diameter (cm)	Bulb diameter (cm)	Onion bulb yield (t/ha)	Green leaves yield (t/ha)
T1-Control	47.77	4.63	10.85	13.89	8.97
T2 -100% RDF (100:50:50kg/ha N-	53.27	5.58	14.68	19.19	12.05

P-K)					
T3-75 % RD of NPK through CF (2 equal doses) (20:12:10:4:0.25:0.50:0.50% N-P-K-S-Mg-Zn-Fe)	51.80	5.47	12.97	17.28	12.17
T4-100 % RD of NPK through CF (2 equal doses)	56.80	5.63	14.25	21.96	13.02
T5-125 % RD of NPK through CF (2 equal doses)	55.40	5.47	14.35	20.91	12.16
T6-75 % RD of NPK through CF (3 equal doses)	54.94	5.53	13.40	19.61	12.82
T7-100 % RD of NPK through CF (3 equal doses)	57.77	6.03	15.13	22.34	12.61
T8-125 % RD of NPK through CF (3 equal doses)	57.67	5.87	14.49	20.23	12.20
Mean	54.43	5.53	13.76	19.38	12.00
SEm±	1.78	0.39	0.81	0.93	0.70
C.D. at 5%	5.40	1.17	2.44	2.83	2.12

Table 4. Effect of customized fertilizer on growth and yield-attributing characters, yield and economics of chickpea

Treatment	Plant height (cm)	Branches /plant	Pods /plant	Pod weight (g) /plant	Grains /pod	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Cost of cultivation (×10^3 ₹/ha)	Gross returns (×10^3 ₹ /ha)	Net return (×10^3 ₹/ha)	B:C ratio
T_1:Control	49.6	3.9	32.9	27.9	1.10	29.3	1.59	1.94	11.6	41.7	30.0	2.6
T_2:50% dose of CF (11:27:0:6.6:0.5% N-P-K-S-Zn)	50.3	4.7	35.5	33.2	1.16	29.8	1.81	2.24	12.6	47.3	34.7	2.7

T_3:75% dose of CF	50.9	4.9	37.2	34.2	1.22	29.9	1.93	2.34	13.1	50.0	36.9	2.8
T_4:100% dose of CF @ 187.5 kg/ha	51.9	5.0	38.9	35.9	1.23	30.6	2.04	2.50	13.6	53.1	39.5	2.9
T_5:125% dose of CF	53.1	5.2	40.4	37.7	1.25	31.9	2.07	2.61	14.0	53.8	39.9	2.8
T_6:150% dose of CF	55.4	5.6	43.1	39.6	1.27	32.8	2.21	2.69	14.7	57.5	42.9	2.9
T_7:RDF (70kg N, 20kg P/ha)	52.6	5.0	39.6	36.6	1.24	31.7	2.05	2.51	13.2	50.4	37.2	2.8
SEm±	0.53	0.19	1.28	0.57	0.01	0.75	0.04	0.04	-	-	-	-
CD (P=0.05)	1.65	0.60	3.94	1.76	0.04	NS	0.11	0.12	-	-	-	-

2. Effect of customized fertilizer on quality parameters of crop: Customized fertilizers (N P K Zn B) enhanced the quality parameters like the head rice recovery (%) and decrease thebroken percentage in scented rice (Kumar *et al.*, 2017).The average number of female flowers as compared to male flowers, the average yield of "ABC" grade fruits, and the 10% increase in marketable fruit yield were all greatly influenced by the CF grades developed based on soil test crop response (STCR) and response curve (RC) approaches with DFPCL CFG on pomegranate (Gol, 2009).

1. Effect of customized fertilizer on soil properties: Interestingly, CF improved WUE under 0.8 IW/ CPE ratio in potatoes and had a considerable impact on soil moisture regime (Irfan, 2017). When a 150% dose of CF was administered to rice crop, NPK and Zn absorption increased. Additionally, it contributed to the soil having substantially more easily accessible NPK during harvest (Shyla *et al.*, 2016).Due to CF's split application, nutrient availability in soil also improved as crop ages advanced

1.Effect of customized fertilizer on energy use: In paddy, maximum net energy output was high. Though, energy consumption efficiency and the output to input energy ratio, were lower. Under a CF dose of 150%, the highest net energy output was attained, which was

twice the control plot. Despite producing less energy output, the control treatment had the highest input-to-output energy ratio because less energy was consumed (Meshram, 2016).

1. Effect of customized fertilizers in cost economics:A difference of 1000 between customized fertilisers and farmer practices in rice fields. Returns on investment (ROI) from CF-fertilized paddy plot demonstrated better results with a B:C ratio greater than 3.0, although farmers practice performed 2.5.The highest net returns were obtained when the IW/CPE ratio was 1.0 and customised fertilisers 8 : 18 : 26 : 1 : 0.1 : 6 (N:P:K:Zn:B:S 150 : 67.5 : 97.5 : 3.75 : 0.37 : 22.5 kg ha-1). Due to the low cost of irrigation and customised fertilisers, a low benefit:cost ratio (1.78) were also reported (Irfan, 2017). When compared to the recommended fertiliser dose or farmers' practises in the wheat crop, the B/C ratio in the customised fertilizer-treated plot was twice (Table 5). (Shekhon*et al.*, 2012)

Table 5. Effect of various levels of customized fertilizers on grain yield, straw yield and harvest index of wheat

Treatments	**CF level (% of MRDCF)**	**Net return (₹/ha)**		**B:C Ratio**	
		Gurdaspur	**Rupnagar**	**Gurdaspur**	**Rupnagar**
T1 (control)	**0**	3261	-4100	1.15	0.55
T2	**50**	40273	18919	2.72	2.25
T3	**75**	47263	47961	2.95	4.20
T4	**100 @ 375 kg/ha**	54793	48367	3.19	4.00
T5	**125**	47560	48220	2.84	3.78
T6	**150**	45289	47688	2.70	3.56
T7	**67**	49370	47691	3.06	4.27
LSD (0.05)		3533	368	0.15	0.02

Manufacturing Methodologies

1. **Chemical granulation:** Slurry granulation and complex granulation are other names for chemical granulation. Instead of using their salts, such as diammonium phosphate and urea, basic raw ingredients including rock phosphate, acids, and ammonia are used here to create fertiliser. To carry out chemical reactions, huge capacity plants are therefore required. Acid and ammonia handling and storage infrastructure costs are very high in this country. Chemical reactions are challenging to carry out, therefore it is less flexible to create a variety of grades.
2. **Bulk blending:** The simplest and least expensive method for producing CF includes just mixing solid fertilisers in a ratio necessary to achieve the desired nutritional ratio. The only equipment needed is for the warehouse, weighing, and mixing. Because of its smaller decentralised manufacturing capacity, it is better able to provide customers with the precise NPK ratio they need. A high quality granular fertiliser material is required, and the physical standard should be such that all fertilisers and raw materials that will be utilised in bulk mixes have identical shapes and sizes. Due to the strict requirements for raw materials in India, large-scale production is not suitable and requires the import of raw materials. But for experimental purposes, it is suitable. (FAI, 2011).
3. **Compaction:** Compaction is also referred to as "dry granulation" because no liquid binders are used in the granulation process. Fertilizer components should be ground into a fine powder before being compressed together under intense pressure. This process produces a lot of dust and yields briquettes or flakes as the end product.
4. **Fluid method:** It is the most effective way to increase yield in an intensive agricultural system. Clear liquids and suspension liquids are two different forms of liquid compositions. If the liquids are in suspension, continual agitation is required. It offers a way of application without any dust. Micronutrients, phosphoric acid, and ammonia mixtures produce a good, uniform liquid fertiliser.
5. **Compound/Steam granulation:** The process of granulation requires uniform size reduction of the solid raw materials used to make fertiliser. Granule agglomeration can be achieved by using hot water or low pressure steam. Using dehumidified air, the materials should subsequently be dried and refrigerated. A dehumidified bagging facility is necessary for hygroscopic materials like urea-containing grades in order to

avoid the products from caking.The manufacture of customised fertilisers on a large scale in India uses this technique.

Challenges:

- The cost of production is the main obstacle. Fertilizers that have already been finished serve as the basic ingredients for customized fertiliser synthesis. The cost of manufacture for these fertilisers is also increased by their complicated and difficult manufacturing methods.
- Due to the complex nature of the production process, a major difficulty is ensuring a consistent and timely supply in response to demand.
- The application of customised fertiliser is constrained by its specificity to crop and region. The constraint is further exacerbated by India's fragmented land holdings.
- Concerns about the marketing problem are also raised by the substantial price disparity between complex and customised fertilisers.
- Lack of appropriate policies to promote the development and use of customized fertilisers.
- Lack of awareness within the farming community.

Conclusion: Customized fertilizers make it easier to apply the entire range of plant nutrients in the proper proportion to meet the demands at various stages of crop growth.It promotes site-specific nutrient management and aids in maximizing the fertiliser use efficiency of applied nutrients in a cost-effective manner. Customized fertilizer is unquestionably a milestone in the fertilizer revolution that may widen the application of Site Specific Nutrient Management and Precision Agriculture. The composition of the customisedfertiliser may include a combination of primary, secondary, and micronutrients depending on the results of soil tests and crop needs.In order to produce high-quality produce, it is essential to offer incentives to farmers that use 100% water soluble fertilizers. It is obvious that a farmer who uses customized fertilizer would not have to purchase various fertilizers or worry about the amount of fertilizer to be added. Therefore, the product would offer farmers the most practical and systematic way for applying fertilizer.Application of customisedfertilisers encourages site-specific nutrient management to obtain the highest possible use efficiency of applied nutrients in a financially prudent way.Balanced fertilisation, site-specific nutrient management, and customisedfertilisers will all be crucial in achieving ambitious future goals. Customized

fertilisers are multi-nutrient carriers that are carefully designed to satisfy a crop's unique nutritional requirements.

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