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CONTENTS

Identification of new source of white rust resistance in Indian mustard [<i>B. juncea</i> (L.) Czern & Coss] from germplasm collected from Uttarakhand hills	112
USHA PANT, RAM BHAJAN, PURNIMA KANDPAL, NEHA DAHIYA, A. K. SINGH and SAMEER CHATURVEDI	
Genetic variability studies for yield and its related traits in rice (<i>Oryza sativa</i> L.) genotypes	119
APARNA, INDRA DEO, CHARUPRIYA CHAUHAN and DEEPAYAN ROY	
Net photosynthesis and spectral reflectance over rice crop under different nitrogen treatments in semi-arid region of India	125
SHWETA POKHARIYAL and N.R. PATEL	
Management of crop with livestock and allied enterprises for sustainable livelihood of small farmers in north Indian plains	131
S. CHATURVEDI, R. SINGH, A. P. SINGH, D. K. SINGH and R. K. SHARMA	
Effect of mulches and irrigation schedules on productivity and water use efficiency of sunflower (<i>Helianthus annuus</i> L.) in Mollisols of India	137
RAKESH DAWAR and MAHENDRA SINGH PAL	
Growth and yield response of black gram (<i>Vigna mungo</i> L.) to foliar nutrition and growth regulator application	144
SUSHIL, OMVATI VERMA, SUBSHA CHANDRA, J.P.JAISWAL and V.C. DHYANI	
Effect of FYM and nitrogen levels on growth, dry matter accumulation, yield and nutrient uptake of brahmi (<i>Bacopa monnieri</i> L.)	151
VINEETA RATHORE	
Studies on flowering behaviour of double type varieties of African marigold (<i>Tagetes erecta</i> L.) in different seasons under Uttarakhand conditions	159
ANUBHAVIYA BISHT, V.K. RAO and D. C. DIMRI	
Effect of pyrolysis temperatures on major nutrients and some physical and chemical properties in biochar produced from different biosources	166
ABHISHEK SAXENA, P.C. SRIVASTAVA, ANAND PATHAK and S.P. PACHAURI	
Status of some extractable macro- and micro-nutrients in soils of Tehri Garhwal district of Uttarakhand	171
AASHISH PRAJAPATI, S. P. PACHAURI, P.C. SRIVASTAVA, ANAND PATHAK and DEEPA RAWAT	
Effect of Stabilized Magnetite Nano Fertilizer on growth, yield and nutrient contents of broccoli (<i>Brassica oleracea</i> var. <i>italica</i> L.) cv. F1 HYB NS-50	180
RAKESH JAT, SOHEB SHEKH, JINALI SHAH, PUJAN VAISHNAV and P. O. SURESH	
Effect of sixteen essential oils on the progeny production of <i>Sitophilus oryzae</i> (Linnaeus)	187
NIDHI TEWARI and S. N. TIWARI	
Bio-efficacy of some essential oils as fumigant against Lesser grain borer, <i>Rhyzopertha dominica</i> (Fab.)	195
NIDHI TEWARI and S. N. TIWARI	

Seasonal changes in yield, composition and fumigant action of essential oil of <i>Murraya koenigii</i> L. against <i>Rhyzopertha dominica</i>(F.) and <i>Sitophilus oryzae</i> (L.) GEETANJLY and S.N.TIWARI	204
Natural enemies of papaya mealybug, <i>Paracoccus marginatus</i> Williams and Granara de Willink in Tarai region of Uttarakhand RADHA KORANGA and R. P. MAURYA	214
Combined effect of entomopathogens with biorationals against Lepidopteran insect pests of greengram KULDEEP KUMAR DUDPURI and J. P. PURWAR	220
Seasonal abundance of predatory coccinellid beetles in different cropping ecosystems at Pantnagar R. NAVEENA MANIMALA, MEENA AGNIHOTRI and J.M. SAM RAJ	227
Diversity of insect pollinators and pollination mechanism in sponge gourd, <i>Luffa cylindrica</i> (L.) Roem MOHAMMAD SARFRAZ KHAN and GAURAVA KUMAR	232
Effect of host genotypes on the severity of sorghum anthracnose MEENAKSHI RANA, YOGENDRA SINGH, DIVAKAR and SEWETA SRIVASTAVA	238
A review on sugarcane smut caused by <i>Sporisorium citamineum</i> and its eco-friendly management SHAILBALA SHARMA	245
Significance of Nutritional Mapping in today's scenario DUTTA A., JOSHI D., BOSE S. and ACHARYA R.	256
Development and shelf-life evaluation of fiber enriched traditional Indian Parotta PAL MURUGAN MUTHAIAH, PRIYANKA, SANTOSH PAL, GOVINDA RAJ T, KHAN M.A., SHARMA G.K. and SEMWAL A.D.	264
To study the effect of maltodextrin, tricalcium phosphate, glycerol monostearate and drying temperature on vacuum foam mat quality parameters of papaya powder SACHIN KUMAR, ANIL KUMAR, P.K.OMRE, JITENDRA CHANDOLA and IFTIKHAR ALAM	277
Design and development of self-propelled onion (<i>Allium cepa</i> L.) digger VISHAL PATEL, DHARMENDRA KUMAR and ANSHU SAXENA	294
Lead toxicity in cattle: A case report NEERAJ KUMAR, MANISH KUMAR VERMA, MUNISH BATRA and ANKIT NAGAR	299
Bovine tropical theileriosis in cross-bred calf: A case report NEERAJ KUMAR, STUTI VATSYA, MUNISH BATRA, MANISH KUMAR VERMA and JIYA VERMA	303
Occupational hazards among veterinarians PARMAR, T., UPADHYAY A. K. and MAANSI	306
Epidemiological factors of COVID-19 POOJA SINGH, MAANSI, N. K. SINGH, and A. K.UPADHYAY	311
Effect of probiotics and growth stimulants on haematological status in Murrah buffalo SAMEER PANDEY, RAJ KUMAR, RAJBIR SINGH, DEEPAK KUMAR, KARTIK TOMAR and SHIWANSHU TIWARI	318
Effect of supplementation of black cumin (<i>Nigella sativa</i>) on growth performance and haematological parameters of commercial broilers NAMITA NAULA, C.B. SINGH, SHIWANSHU TIWARI and DEVESH SINGH	325

Significance of Nutritional Mapping in today's scenario

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ABSTRACT: Nutritional mapping is defined as making an outline with the help of several surveys to form an interactive map, with a clear image of nutritional and food status at different regional and state levels. The nutritional mapping system helps to detect community health issues and sketch intervention programmes using data of many years. In this era of satellite imaging, online data and GIS system support, the process of nutritional mapping system has improved greatly. Nutritional mapping can be used at local, community, national and international level. Mapping the magnitude of a nutritional problem and measures taken to minimize them is essential for pointing out lacunas and for the further development of the nutritional status. However, there is a possibility of Human error or technical error while dealing with large amount of data. A standard nutrition mapping method may be developed globally which can be used for a small community as well national and international level, to bring uniformity to this very important tool of nutrition science.

Key words: Community, error, food status, mapping, nutritional

What is Nutritional Mapping?

The 21st century has witnessed to many nutritional deficiency and excess diseases which have had severe implications on the overall well being of mankind. Some diseases are limited to some specific regions and some are spread all over the world. Severe acute malnutrition affected approximately 20 million children (under 5 years) across the world (Uauy *et al.*, 2012) and caused nearly 8 million under-five deaths worldwide (Aguayo *et al.*, 2012). Globally in 2020, 149 million children under 5 were estimated to be stunted (too short for age), 45 million were found to be wasted (too thin for height), and 38.9 million were overweight or obese (WHO, 2021). In India 35.70 per cent of children under 5 years are underweight (NFHS, 2016). One third of the women worldwide are anaemic. It is estimated that 42% of children less than 5 years of age and 40% of pregnant women worldwide are anaemic (www.who.int/health-topics/anaemia#tab=tab_1). In India 58.4% of children aged 6–59 months, 50.3% of pregnant women aged 15–49 years and 54% of adolescent girls are anaemic (NFHS, 2016).

To combat the problem of malnutrition effective programmes and policies are required. For practical decision making, program managers and policymakers need detailed information about specific areas which are most affected by poverty and under-nutrition. Household surveys are an important source of information, but the typical sample size is only a few thousand observations. So the information is only useful for inferences at high levels of aggregation. In contrast, data sources with wider coverage, such as national censuses, rarely capture detailed information on welfare levels. In this condition nutrition maps may act as reliable source of information for decision makers (Simler, 2006).

According to USDA Nutrition Mapping is defined as making an outline by the help of several surveys to form an interactive map, which gives a clear image of nutritional and food status at different regional and state level. The process shows the prevalence of different nutritional deficiency and excess diseases in a specific region (U.S. Department of Agriculture Portal, 2021).

Types of maps used for nutrition mapping

A) Choropleth map. Currently data can be represented as thematic maps in different ways, including the commonly used choropleth maps in which a defined area, such as an administrative district, is shaded or patterned to indicate a certain value. The advantage of the choropleth map is that it is simple to analysis and understand. Figure 1 is an example of a choropleth map.

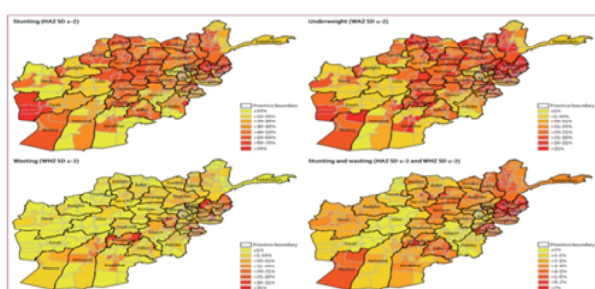


Fig 1: Choropleth Map

B) Dot point map is thematic map that uses large numbers of dots or points to portray the relative geographic distribution of a population of some kind (Fig 2). In Dot maps each dot may represent either a single individual, or a representative group of individuals, and dots are placed according to the precise or estimated locations of the unit (individual/group of individuals). In a dot density map, all dots used are of same size and these dots do not represent actual point locations of data. Due to the random placement of the dots in every area represented on

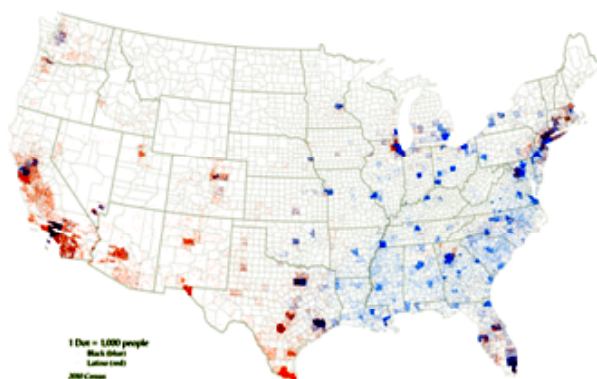


Fig 2: Dot density map

the map, it is important to use the smallest unit area to display the data. Dot points map is also an alternative to present survey data but it is slightly difficult to analyse and understand (Seal, 2018).

Scope of Nutrition Mapping

The nutritional mapping system helps to detect community health issues and sketch intervention programmes from many years (Krieger, 2003). The technology has become advanced day by day. So, in this era of satellite imaging, online data and GIS systems assist in making the nutritional mapping system better.

Examples of mapping the nutritional status of a population

A mapping exercise was carried in the 2018 in Afghanistan to identify geospatial inequalities and determinants of nutritional status among women and children. The study used the data from Afghanistan National Nutrition Survey 2013. Growth and weight anthropometry data, Z scores were measured. Approximately 14,000 mother-child pairs using Bayesian spatial and generalised least squares regression models accounting for the complex survey design were used. The outcome was represented as a map (Akseer *et al.*, 2018).

In the year 2006 another mapping programme was conducted in Tanzania to assess nutritional status of children. They used census data and anthropometric measurement to conduct this study. This analysis found that applying small-area estimation techniques to anthropometric data is feasible, and it detects significant differences in undernutrition prevalence between districts and sub districts. (Simler *et al.*, 2006)

Mapping the impact of nutritional policies and programmes

Nutrition mapping was also carried out by an international organisation named Nutrition International during the period of July – December 2016 to sketch the information system of nutrition

in SUN (Scaling up nutrition) countries. They defined a substructure which categorizes typology and states of advancement of the information systems by the help of National Assessment Data and National Performance Monitoring Data. (Nutrition International, 2017) The mapping process is essential for assessing existing nutrition policies and its evaluation. In the year 2016 WHO organized a mapping study in eighteen countries in Latin America to map the existing policies for malnutrition and analyse gaps. They used internet enabled information for this descriptive study. (Tirado *et al.*, 2016)

Similarly, World Bank also performed a mapping exercise to estimate existing nutrition and early child stimulation programs in Tanzania in 2018. They accessed operational strength, challenges and opportunities and gave a clear picture to Tanzania government on new project and invention implementation (World Bank, 2018).

Burkina Faso setup a map to prioritize nutrition interventions and evaluate how these interventions contribute in multi-sectoral nutrition processes. The exercise was planned like a cross sectional study by utilizing the Excel-based Scaling Up Nutrition Planning and Monitoring Tool (SUN PMT) to analyse data. The analysis included the distribution of nutrition stakeholders for each intervention, the calculation of geographic and population coverage for each intervention, as well as the utilization of delivery mechanisms to reach beneficiaries (Doudou *et al.*, 2018).

Mapping in Nutrition Education

The mapping system also helps to know the nutrition education efficacy in different regions of states and countries. In the study of Marchand *et al.* (2007) the knowledge and the food patterns of diabetic children and their parents were studied and a conceptual map was designed which further helped them in nutrition education.

In 2011 a mapping exercise was conducted in India to map nutrition teaching and training initiatives in the country. For this study internet search, telephone calls, interview methods were used. Collected

information was pooled and tabulated using a snowball approach. The study found there are almost 190 institutes in India that offer one or more nutrition courses, with the majority offering full-time courses. Public health and nutrition was offered in less than five institutes across India (Khandelwal *et al.*, 2011).

Mapping Food Security

Food insecurity of the world can also be studied through a mapping exercise. With this purpose in 2010 FAO formed a data management and mapping tool to improve informed decision making in food security. (FAO, 2010) A study on mountain people's food insecurity in the year 2015 across the world used GIS based survey system for survey. The study defined vulnerability to food insecurity as the probability of a person or household falling or staying below a minimum food security threshold within a certain time frame (FAO, 2015). Farrukh *et al.* (2020) stated that systematic mapping food security studies has been conducted, methodologies used, and dimension of food security have been considered in the academic literature in Pakistan, Bangladesh, and India. This has helped to identify research priorities and gaps.

In India ICMR-NIN conducted a mapping exercise to find out locally available foods which can combat malnutrition in children and select most potential food items (NIN-ICMR, 2019). Very recently ICMR-NIN has developed a national online survey on "Mapping Nutrition and Health Status – A National Level Participatory Real time Data Generation Programme" This study will assess nutritional status, food frequency and diversity across the country. It will also help to find out the food behaviour of children, adolescent people and the mothers of young children in the country (NIN-ICMR, 2021).

Mapping studies were also conducted to know the drinking water supplies and sanitation process across a region or country. A mapping and spatial analysis exercise was performed in the whole sub Saharan continent to understand geographic inequalities in coverage of drinking-water supply and sanitation and identify the bottom line population which helps to control the spread of infectious diseases. Cluster-

level data on drinking-water supply, sanitation, and open defecation were collected from 138 national surveys undertaken from 1991–2012 in 41 countries. Spatially explicit logistic regression models were developed and fitted within a Bayesian framework (Pullan *et al.*, 2014).

Methodology of nutrition mapping

Several nutrition intervention programs, policies related to nutrition and other sectoral policies are implemented based on briefings of the nutritional status of the vulnerable groups in the community at national and international level. Nutrition related policies are those which are directly or indirectly related to food, human nutrition, security of food; whereas sectoral policies are those which include agriculture, food, education, maternal and child nutrition, poverty reduction, social protection etc. (Tirado *et al.*, 2016). Nutrition mapping is a method of validating the current nutritional status of a community or nation by exploring or surveying these interventions or policies in that location. It is also used to key out the best way to scaling up the priority interventions. Various methods of nutrition mapping are discussed below.

Nutrition mapping at Local Level

Availability of food in a community plays a crucial role in maintaining nutritional status of the community, so at the local level nutrition mapping is done to analyze the local food sources. It helps in ensuring food security. First the map of the local area is obtained and the food options like food market, grocery stores, farmer's market, farms are identified and then food purchase options for specific food are assessed and indicated in the map. After the completion of the map, a set of questions are prepared and healthiest options available to community are determined. Then the analysis is interpreted using software, graphs and tables (Community Nutrition Project Ideas 2019)

Nutrition mapping at Community level

At the community level, the information on nutrient

intake, physical activity, body weight, eating patterns and food security are collected from the target group to find out the behaviour as well as health and nutrition of humans. This primary resource tool furnishes a series of easily accessible tables and colour coded maps which are comprehensive and easily understood by the policy makers, nutritionists and other public health workers at the community level. By studying this map the health professionals can assess the nutritional status of the community, and infer whether the target group is nutritionally sound or there is a necessity of nutrition intervention (Bliss, 2003).

Nutrition mapping at National and International Level

Another method of nutrition mapping is by using SUN PMT (Scaling up Nutrition Planning and Monitoring Tool), an excel based tool that was earlier used by the govt. of Burkina Faso and Egypt to study the efficiency of ongoing nutrition related programs in those countries (Doudou *et al.*, 2018; MOHP, 2017). This method can be used both nationally and internationally. It combines primary and secondary method of data collection.

In this method a cross sectional study is carried out. The SUN PMT tool which is enclosed with macros is used for data collection, storing and analysis. The cross sectional study is conducted in four stages that are preparatory, data collection, data analysis and interpretation.

The preparatory stage includes setting up of mapping task force team, their training in methodology and use of tool, defining the core nutrition action to be mapped which comprises of identification of key target group and the intervention to be included as well as the method of data collection (from whom and why). In this step the stake holders (Government or non-government) are also informed and involved. Then the SUN PMT tool is customized to include the country specific core nutrition actions or interventions linked with target group and the service delivery mechanisms. In the final stage of customization the nutrition situation indicators like

stunting, wasting, anemia, food insecurity are added which are linked to the specific interventions. The customization also includes the entering of data related to total target group population and total population at national and sub national level. The population data is obtained from the survey reports of government departments and ministries.

The next step after preparatory phase is data collection. The data related to the objective or interventions are collected from the stakeholders who work to promote health. For example in national level ministries like health, food processing, women and child development, agriculture & in international level several NGOs, implementing partners, United Nation agencies can give information. The data are collected either through questionnaire or by interview.

At national level, the data related to the interventions are collected by assessing state wise information, for example: in how many states the intervention program has been implemented, how many beneficiaries are there, which organizations are involved and which delivery mechanism is involved. Similarly at international level, data is collected by assessing country wise, considering the above questions.

After data collection, the data is analyzed properly using the reporting and visualization featured in SUN PMT tool. It analyzes the target group and geographic coverage at national and sub national or international level. Errors are detected by the automated tables. At national level the geographic coverage and population coverage are calculated using formulas and denoted in percentages for the interpretation of the data.

Geographic coverage (%) = Number of states reached by intervention / Number of total states $\times 100$.

Population coverage (%) = Number of individuals in target group reached by intervention / Total target population for a target group $\times 100$.

The analyzed data is then interpreted using maps, graphs, and tables on the basis of the coverage of intervention.

Nutrition mapping of various regions within a country

At regional level within a country, nutrition mapping is done by using small area estimation method. For example in Cambodia, a Geographic Information System (GIS) database and an elaborate variance structure have been used to study the pattern of undernutrition (Fujii, 2005). Similarly in Brazil, nutrition mapping has been done by generating point estimation and geographically targeting the malnourished child (Gilligan and Veiga, 2003). In Tanzania also small area estimation method has been used and the nutritional status of the children has been measured first using anthropometry and the Z score, which is useful in comparing the child growth to international reference methods (Simler, 2006). Here the household surveys also give a view of nutritional status of that region. The small area estimation method provides a precise map of nutritional status of the small region within a large country and is also helpful in identifying the hotspots where intervention is needed the most.

Another methodology adopted in multiple countries for mapping out the nutrition is the systematic internet searching and mapping of public nutrition intervention programs and policies currently functioning to boost the nutritional status of multiple countries. This method was used before by Latin American countries for mapping the nutritional status to address malnutrition in 18 countries (Tirado *et al.*, 2016). In this method the data is collected from the secondary sources. The document can be obtained from the websites of ministries like health, education, labor, agriculture or from other government agencies. It also considers the documents of WHO, UNICEF, WFP, World Bank and other international organizations working in this direction.

The collected information is next imported in a descriptive matrix database with a structure similar to the five comprehensive implementation plan (CIP) Priority lines of action and recommendations, which were given by WHO for the action of CIP on maternal, infant and young child nutrition and has

to be followed by the WHO member states. Each of the five CIP lines of action and its corresponding set of current activities are allotted with binary codes. The policies or interventions which a country implemented are coded against the recommended activities for implementing the five WHO CIP Priority lines of action and coded as yes or no. If the country has any nutrition or related sectoral policies then the coder codes it as 'Y', if not then as 'N'. In this way the number of policies supporting each CIP priority line of action are mapped and tallied.

Globally nutrition interventions are mapped out. Here the stakeholders are NGOs, UN organizations, government departments, ministries of country, and independent organizations working towards the welfare of the health and nutrition. This type of methodology was used in a study for mapping out the adolescent nutrition (Zakari *et al.*, 2020). The data on burden of malnutrition or other problems for a particular target group having cut off points, metrics, policies and strategies are studied, and then the interventions and programs already implemented are assessed. Nutrition outcomes of interest are categorized as micronutrient status, under nutrition including wasting, stunting, Overnutrition and other dietary pattern and behaviour.

Questionnaires containing both quantitative and qualitative questions are put before the stakeholders or respondents. Also, they are asked to upload related documents and web address, so that the program can be evaluated. Statistical tools are used to dissect the quantitative data whereas the qualitative data are analyzed with regard to the related problems. The documents provided by the stake holders are then summarized and scaled.

Limitations of nutrition mapping

- There is a possibility of Human error or technical error while dealing with large information.
- The reliability of the information provided by the ministries depends upon the data collection methods at various levels. Also the number of beneficiaries benefitted under the intervention program is not certain.

- There is a vast reality difference between the functions of the policies or interventions at various level and the documents obtained from upper level.
- The methods of measuring nutritional status undertaken by various countries may differ. So it needs additional refining when nutrition mapping is done globally.

CONCLUSION AND RECOMMENDATIONS

Mapping the magnitude of problems and measures taken to minimize them is essential for pointing out lacunas and for the further development of the nutritional status of populations. To get a reliable result in nutrition mapping both primary and secondary data sources should be used complementarily. The information must be collected at grassroot level by engaging trained professionals and related government organizations working in that field like ICDS. The method used should be reliable, reproducible and specific to a particular nutrition problem. There should be a standard nutrition mapping method globally which can be used for a small community as well as for a country or for multiple countries, so that human errors can be minimized. The studies should not be only based on malnutrition but should focus on mapping of micronutrient deficiency as well as over nutrition problems and their interventions as these are the emerging constraints to human development.

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